STRIPPING THE MYSTERY FROM RADIANT HEATING

See Page Two

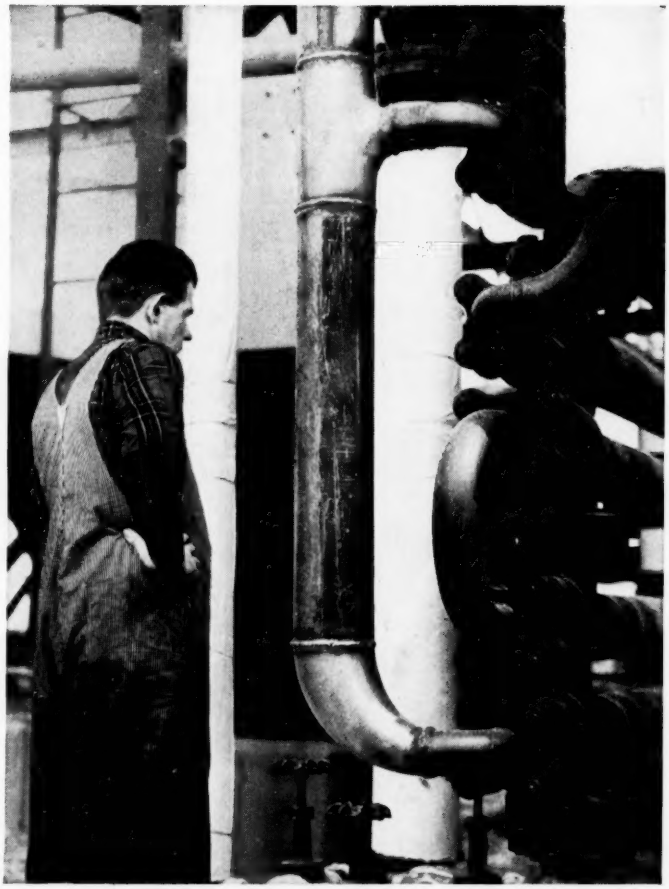
You get these extra values at no extra cost with

TUBE-TURN®

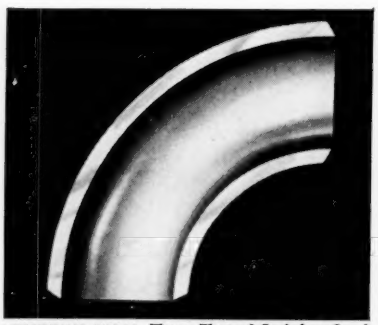
Stainless Steel Fittings

- Fittings meet *all* standard chemistry specifications
- Minimum wall thickness of elbows at least 87½% of nominal
- All fittings meet calculated bursting pressure of matching pipe
- Qualified welders and procedures used where welding is required
- Each fitting properly solution heat-treated
- Each fitting passivated
- Special grades of stainless steel and all other alloys available

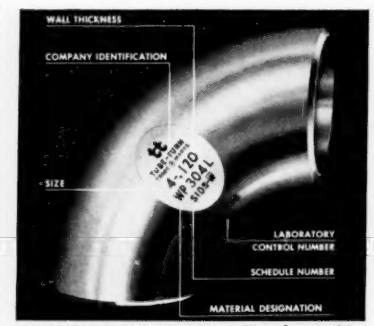
Meet all standards: ASTM A403 (for material and manufacturing procedure); MSS SP43 and ASA B16.9 (for dimensions); and MSS SP25 (marking procedure).



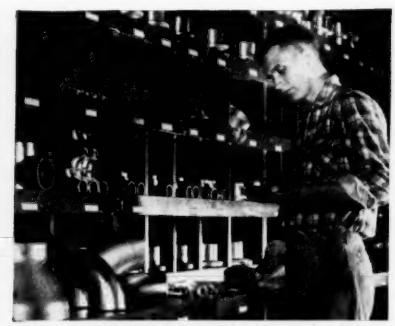
TUBE-TURN® Stainless Steel Elbows and Tee in a petrochemical plant.



UNIFORM WALL. TUBE-TURN® Stainless Steel Elbows meet ASA standards of 87½% of nominal thickness... particularly important for light wall fittings. Many conventional stainless steel elbows are as much as 30% to 40% below nominal thickness. All TUBE-TURN Fittings match calculated bursting strength of the pipe.



COMPLETE IDENTIFICATION. You *know* this fitting conforms to specified quality because the material type and quality control are fully identified. Manufacturer, size, wall thickness and schedule are also marked as shown on the fitting.



CUTS PURCHASING COSTS. You can order TUBE-TURN Stainless Steel Fittings from your nearby Tube Turns' Distributor . . . on the same order as other types of welding fittings in Tube Turns' line of 12,000 products. Cuts red tape. Saves time.

The trademarks "tt" and "TUBE-TURN" are applicable only to the quality products of Tube Turns.

tt TUBE-TURN

TUBE TURNS

A DIVISION OF NATIONAL CYLINDER GAS COMPANY

Louisville 1, Kentucky

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago Detroit • Atlanta • New Orleans • Houston • Midland • Dallas • Tulsa Kansas City • Denver • Los Angeles • San Francisco • Seattle

IN CANADA: TUBE TURNS OF CANADA LIMITED, Ridgetown, Ontario
DISTRICT OFFICES: Toronto, Ontario • Edmonton, Alberta Montreal, Quebec • Vancouver, B. C.

APRIL 7, 1958

JOHN R. CALLAHAM, Editor-in-Chief

More For the Design Man . . .

Back in January I told you that CE would publish more material of specific appeal to design and development engineers.

We're keeping that promise, and in this issue you'll find a brand new department—Design Notebook—aimed squarely at men in these functions.

Design Notebook will deal with needs of equipment design engineers and of development engineers in design and operation of small-scale and pilot plant equipment.

It will specialize in smart kinks, shortcuts, do-it-yourself ideas and in "compressed data" in the form of formulas, charts and nomographs. It'll be eminently practical in its approach.

You'll recognize at once that this new Design Notebook is patterned after CE's unique 35-year old Plant Notebook, a favorite among production men for decades.

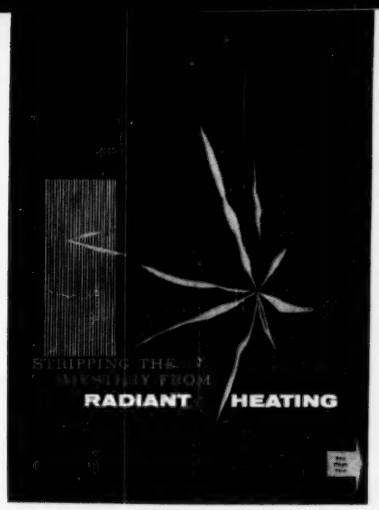
That's true, and for the time being each of these first-cousin departments will appear in alternate issues.

We'll continue to make available, of course, just as many "kinks and shortcuts" for the plant man as ever before—perhaps even more. In addition, Plant Notebook fans will find many items of interest in the new design section—and vice versa.

Design Notebook will be handled by Senior Editor T. R. Olive. Ted has edited Plant Notebook since 1927 and has built it up to its present enviable stature among engineers.

Like so many of the ideas we adopt, this one for Design Notebook came from one of our subscribers: Gerald Lessells, then with Olin Mathieson, now with USI.

We recommend Design Notebook to all engineers in design and development work. It begins in this issue, and you'll find it on p. 158.



SEVENTH OF TWENTY-SIX ISSUES

7/26

GUIDED TOUR

After we strip the mystery away, where can you use radiant heating?

There's no need for a complete mastery of theory. You can design or intelligently select radiant heating equipment when you know a few of the fundamentals. Most applications, so far, have been in drying. Where are the places in your processes that you can now profitably put this kind of heat to work? (p. 137)

Where smart engineering paid off

Expensive traditional sinter-and-smelt steps are relics of the past at one Inco plant. Clever new process wins 99.9% pure nickel from sulfide by electrolysis. Pure sulfur is recovered too. (p. 60)

Chart ties eight variables together

Here's a quick, handy way to estimate variables in turbulence mixer design. It'll

Chemical

April 7, 1958

GUIDED TOUR

relate operating variables to fluid and physical properties. Keeps decimal points in their places, too. (p. 141)

How to put rupture disks to best use

Now you can check all the ways to design and install rupture disks. How to add these weak-spots so they'll protect your operations under wide conditions of temperature and pressure. (p. 143)

New worksheet finds best conditions

With this sheet and about 12 tests you can find the optimum point of a process. It's based on the new Box method but you don't need to be a statistician to handle up to seven process variables. (p. 151)

What's wrong with education

Two well-qualified experts take a hard look at what chemical engineering education needs today. How far can you concur with their recommendations? How well do their observations match yours? (p. 173)

CE is edited for the engineer concerned with chemical operations, whatever his function . . . administration, production and plant operations, design and construction, research and development, sales and purchasing. More engineers subscribe to CE than to any other magazine in the field. Print order this issue:

47,532

Developments in Chemical Engineering

Practice of Chemical Engineering

Engineering

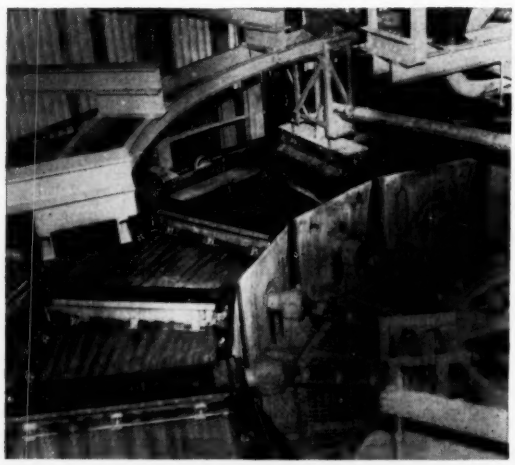
Vol. 65, No. 7

need a good wash?

Whenever your solid-liquid separations call for thorough washing with minimum quantities of wash liquor —

And whenever wash liquors have to be kept strictly separate from the mother liquor—

this BIRD-PRAYON Horizontal Tilting Pan Vacuum Filter is FOR YOU.



Other significant BIRD-PRAYON Filter advantages include:

great range of filter area — from 27 sq. ft. to 516 sq. ft.

long filter cloth life — a fresh, clean cloth is presented to the feed each time it is delivered to the pan; this means uniformly high efficiency as well as long life

low operating cost — the Bird-Prayon is automatic and trouble-free in operation

Ask us to make recommendations, layouts and estimates.

BIRD

LEADING AUTHORITY ON SOLID-LIQUID SEPARATIONS

Builders of

- Bird Continuous Centrifugal Separators
- Bird-Prayon Continuous, Rotary, Horizontal Vacuum Filters
- Bird-Young Single Cell Rotary Vacuum Filters
- Bird Horizontal Tank, Vertical Leaf Pressure Filters
- Bird-Humboldt Screen Type Oscillating Centrifuges
- Bird Suspended Centrifugals • Bird Centrifugal Classifiers
- Bird Continuous Centrifugal Coal Filters • Bird Polishers
- Bird Centriweeces for delicate Crystals, Fibrous Materials

For specific information on individual machines write:

BIRD MACHINE COMPANY
South Walpole, Mass.

Regional Offices:
Evanston, Illinois
Walnut Creek, California
Atlanta 18, Georgia

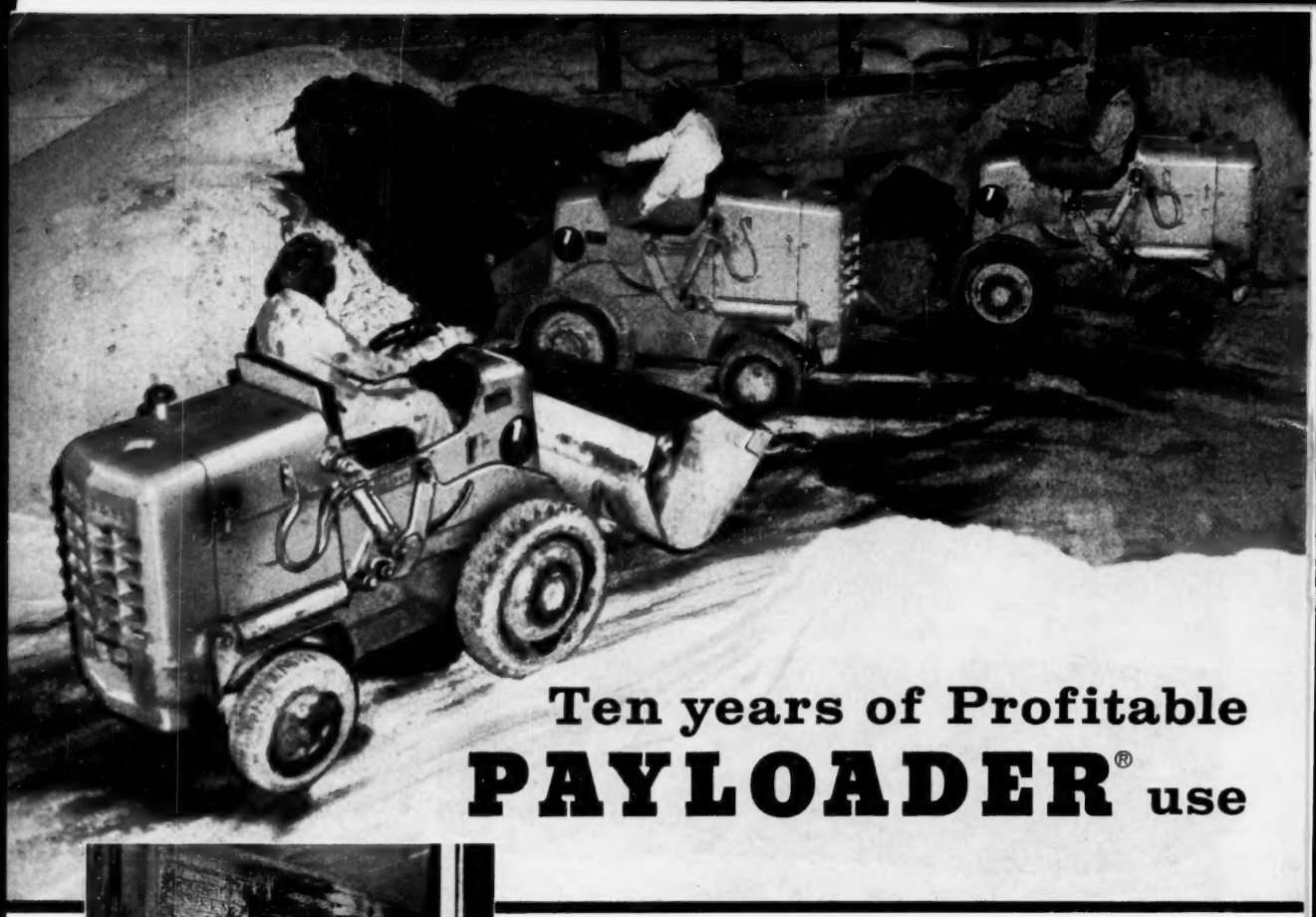
Chemical Engineering

This issue's top features of significance in

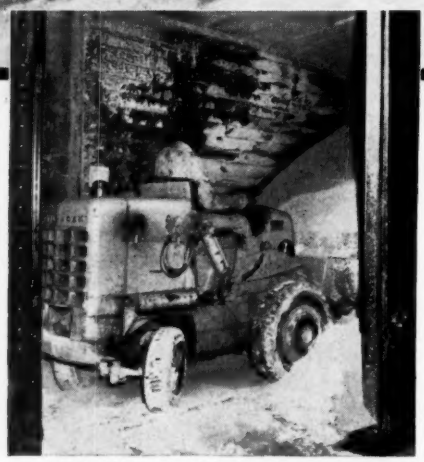
Petrochemicals & Petroleum Refining

APRIL 7, 1958

Also of Basic Interest



Ten years of Profitable PAYLOADER® use



50 Tons Per Hour!

One of Maloney's model HA "PAYLOADER" units can unload a 50 ton car of superphosphate in 45 to 60 minutes with 35 ft. one-way haul.

"Our long experience with 'PAYLOADER' tractor-shovels has thoroughly job-proven them on our operations" says A. J. Nolen, Superintendent for Maloney Fertilizer Company, Charleston, S. C. "The new model HA roll-back bucket action and the torque converter drive has almost doubled the production and greatly reduced the normal maintenance. The roll-back, low-carrying action also means less spillage insuring a cleaner, safer operation."

Fertilizer mixers and chemical plants of all sizes have proven in their own plants that the superior experience and design in "PAYLOADER" tractor-shovels pays off with more production and performance.

There is a "PAYLOADER" size for your every tractor-shovel use, beginning with the popular model HA, and up to 9,000 lb. carry capacity. They all feature the 40° roll-back bucket action and hydraulic load-shock-absorber that carry big loads low and close with maximum stability and safety, and minimum spillage loss.

See your Hough Distributor for full details. Ask him, too, about scarifier teeth attachments to loosen packed fertilizer, and about Hough Purchase and Lease Plans.

THE FRANK G. HOUGH CO.
754 Sunnyside Ave., Libertyville, Ill.

Send "PAYLOADER" information on:

- ☐ model HA (2,000 lb. carry capacity)
- ☐ model HAH (3,000 lb. carry capacity)
- ☐ Larger models (up to 9,000 lb. carry cap.)
- ☐ Scarifier Teeth Attachments.

Name _____

Title _____

Company _____

Street _____

City _____ State _____

4-A-1

SAY "HUFF"

Modern Materials Handling Equipment

THE FRANK G. HOUGH CO.

LIBERTYVILLE, ILLINOIS

SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY

New Team . . .

TITANIUM AND ZIRCONIUM

for your corrosion problem areas

TYPICAL CORROSION RESISTANCES OF ZIRCONIUM AND TITANIUM

CORROSIVE MEDIA	METAL RESISTANCE	
	ZIRCONIUM	TITANIUM
Sulfuric Acid	excellent to good below 80°	good below 5%
Nitric Acid	excellent	excellent
Hydrochloric Acid	excellent	good below 10%
Phosphoric Acid	excellent to fair below 85°	poor
Chromic Acid	excellent	excellent to good
Aqua Regia	poor	excellent
Wet Chlorine Gas	poor	excellent
Chlorine Water	excellent	excellent
Sodium Hydroxide	good below 90%	good below 50%
Ferric Chloride	poor	excellent
Calcium Chloride	excellent	excellent
Cupric Chloride	poor	excellent
Sodium Chloride	excellent	excellent
Ammonium Chloride	excellent	excellent
Aluminum Chloride	excellent	excellent to fair

Chart shows corrosion resistances of zirconium and titanium to typical chemicals.

Steam jet made of zirconium, which has given trouble-free performance after a year in hydrochloric acid service. For comparison, a throat piece from a steam jet (below) is shown after only a week of similar service.

By specifying titanium or zirconium for processing equipment, you can now overcome most of the corrosive media which attack other metals.

Even with such hard-to-handle chemicals as chlorides and oxidizing acids, equipment can have extremely long service life when made from these corrosion-resistant materials. Problems of product contamination in chemical and food processing can also be virtually eliminated.

Mallory-Sharon is in position to offer you *both* titanium and zirconium mill products for equipment fabrication—plus engineering assistance and unbiased recommendations on the most suitable material.

Titanium is now available from stock in a complete range of mill products, may be readily fabricated, and more than pays its extra cost where ordinary metals fail. Zirconium facilities are being rapidly increased, and mill shapes are now in production.

For information on the corrosion-resistant properties of titanium or zirconium write Mallory-Sharon Metals Corporation, Niles, Ohio.

See our 4-page ad in Chemical Engineering Catalog, Pages 1147-1150, for additional technical information.

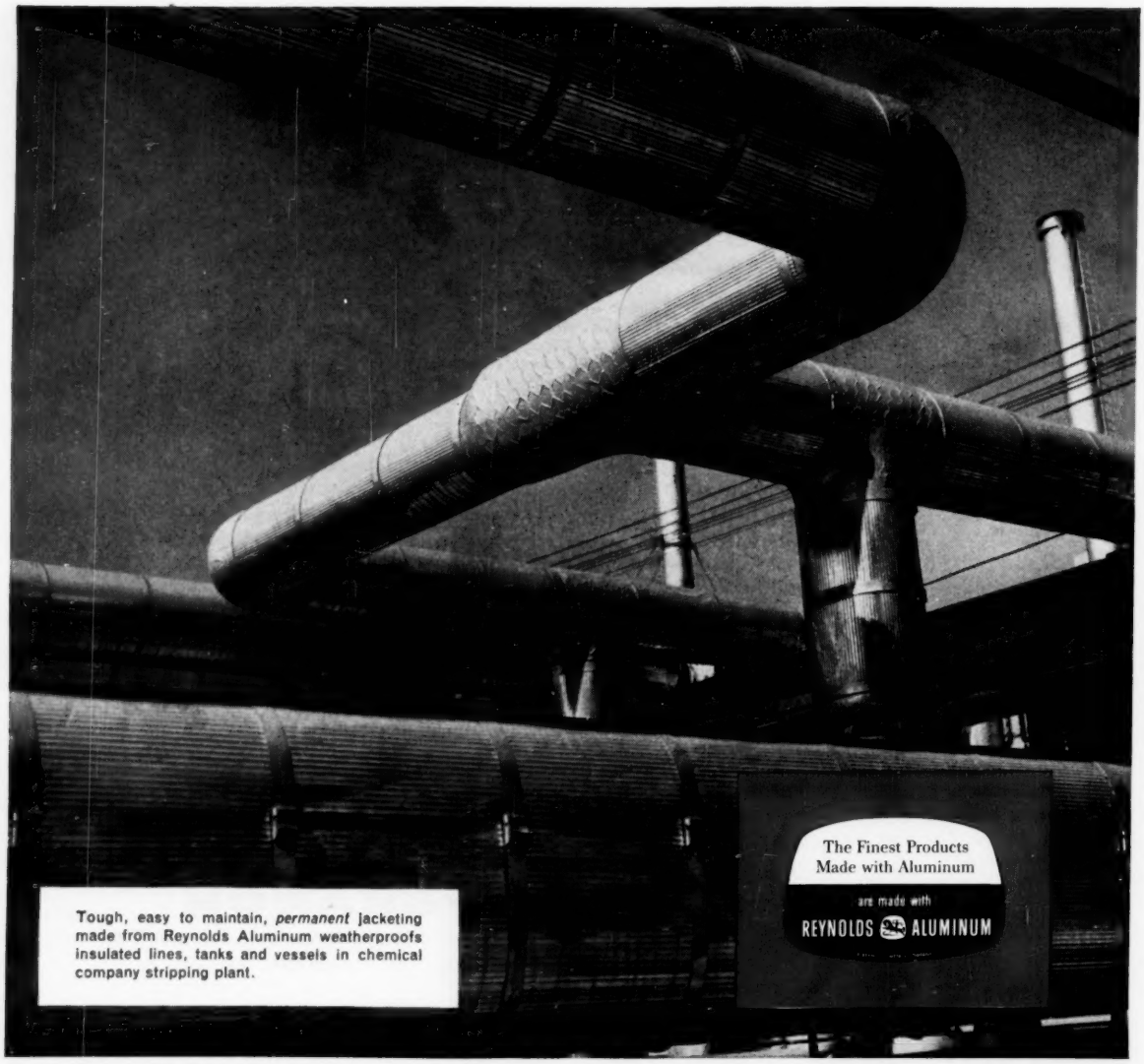
MALLORY-SHARON

METALS CORPORATION • NILES, OHIO

Integrated producer of Titanium • Zirconium • Special Metals

Aluminum Jacketing

...how it improves appearance, cuts installation, maintenance costs



Tough, easy to maintain, *permanent* jacketing made from Reynolds Aluminum weatherproofs insulated lines, tanks and vessels in chemical company stripping plant.

Aluminum is the one permanent jacketing material, a material that stays clean and new-looking with a minimum of upkeep. And that holds true in the toughest jobs in the chemical and petroleum processing industry. Jacketing made from Reynolds Aluminum cuts costs in many other ways, too. Here's how:

CORROSION-RESISTANCE

Many industrial atmospheres, chemicals, gases and contaminants literally eat jacketing materials away. But they don't bother aluminum. Reynolds Aluminum Jacketing stays strong, clean and rust-free in the most corrosive atmospheres, handling the most corrosive materials, in any climate or weather condition. *And it needs no repetitive maintenance.*

EASY TO INSTALL

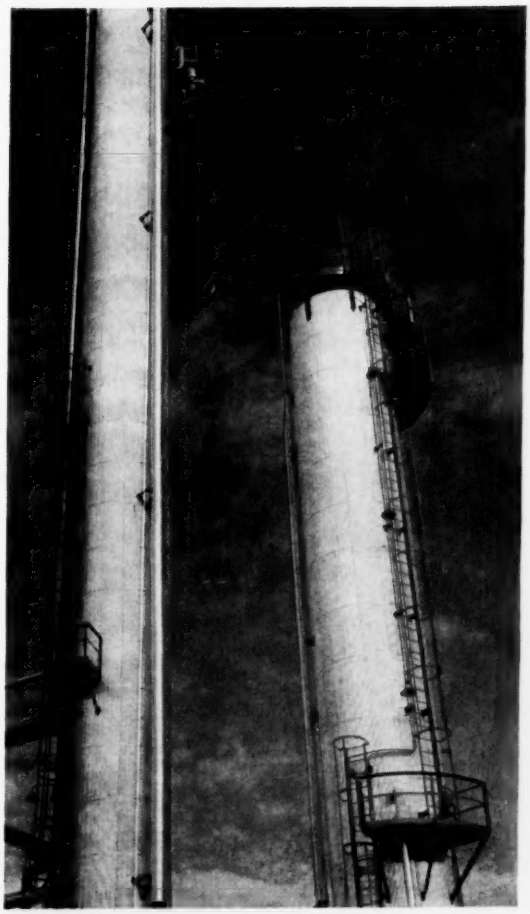
Lightweight aluminum is one of the most workable, formable of metals. That means faster, easier installation, and less time and labor on the site. You can cut and shape Reynolds Aluminum Jacketing with ordinary hand tools, and can use larger sheets because it is so light. Weighing only ⅓ as much as steel—or less—aluminum jacketing can save in shipping, handling, installation and supporting structure costs.

GOOD INSULATION PROPERTIES

Aluminum jacketing has a low factor of emissivity—it keeps heat *inside*—a big added advantage when you're handling or storing hot fluids. Then too, aluminum reflects as much as 95% of radiant heat. That means it protects volatile products from costly evaporation losses.

NON-SPARKING

Flammable and explosive materials are safer when aluminum is used for jacketing or handling equipment, because aluminum is non-sparking and won't burn.



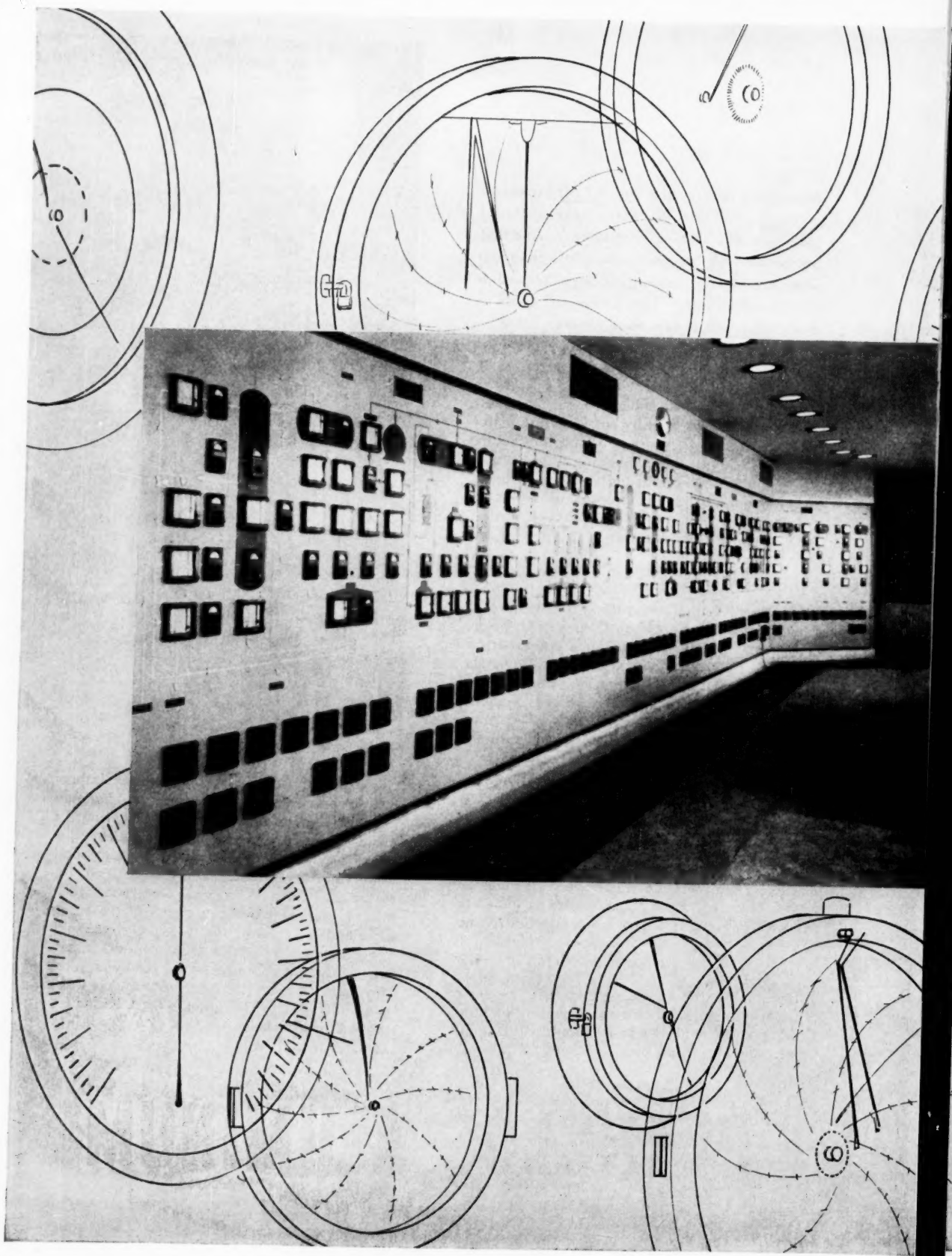
Suntide Refining Co. tower in platforming and rexforming unit—jacketed in Reynolds Aluminum.

Of course, aluminum's properties are important to chemical and petroleum processing men in other applications as well as jacketing. In process pipe, for example, or oil country pipe, where Reynolds Aluminum's light weight and weldability saves hundreds of man-hours on installation. Tanks and vessels, heat exchangers, drilling rigs and offshore rigs are all using more and more aluminum, too.

For details on how Reynolds Aluminum can help you, or for technical service, call your local Reynolds office or write *Reynolds Metals Company, P.O. Box 1800-CJ, Louisville 1, Kentucky; International Division, 19 East 47th Street, New York 17, New York.*

REYNOLDS ALUMINUM

Watch Reynolds All-Family Television Program "DISNEYLAND", ABC-TV.



AMERICAN-MICROSEN

FLEXIBILITY

anticipates ever-changing needs in process control

Some day your plant processes will include data handling or computing systems. Your processes will be changed to boost efficiency or to make new products for tomorrow's markets. You will use product stream analyzers.

Is your instrument system adaptable to keep pace with changes experience dictates in operating new processes?

The American-Microsen Electronic Process Control System is flexible. It is designed to solve ever-changing problems of process control. The DC signal used throughout is compatible with data handling systems. Changes in control arrangements are easy to make. Simply rewire instruments already on the job and plug in new components as needed. Standard instruments can be used for cascading, ratioing, programming, etc.

Flexibility is but one American-Microsen System advantage. Installation and operation are more economical. Accuracy is higher and control is closer whatever the distance between process and control room.

Try out the American-Microsen Process Control System. Write for information and ask one of our sales engineers to call. He will gladly explain how you can use the system profitably.

MANNING MAXWELL & MOORE M M & M TRADE MARK

MANNING, MAXWELL & MOORE, INC.

INDUSTRIAL CONTROLS DIVISION • DANBURY, CONNECTICUT

MAKERS OF 'AMERICAN-MICROSEN' ELECTRONIC INSTRUMENTS FOR MEASUREMENT, TRANSMISSION AND CONTROL


ANOTHER IN A SERIES
OF MOTOR FACTS
FROM ALL INDUSTRIES

Westinghouse motors double normal life for this application

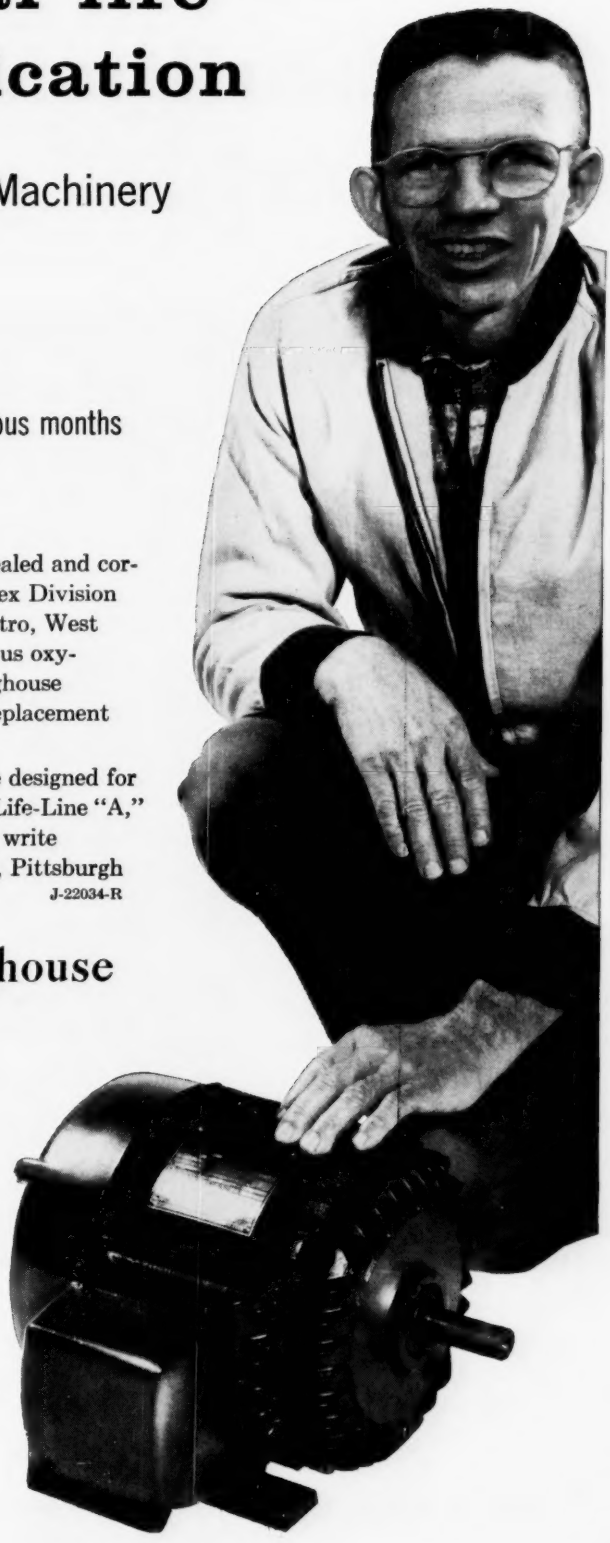
. . . at Ohio-Apex Div., Food Machinery and Chemical Corp.

this standard Life-Line A motor
still pumping corrosive POC I_3 after 12 continuous months
without maintenance or down time

"We must have a dependable motor, completely sealed and corrosion-resistant," says Mr. Burton Fitch, Ohio-Apex Division of Food Machinery and Chemical Corporation, Nitro, West Virginia. "A corrosive atmosphere, plus phosphorous oxychloride drip and seepage, cuts motor life. Westinghouse Life-Line® "A" motors have already passed this replacement point twice . . . and are still going strong."

Westinghouse motors last longer because they're designed for modern industry's needs. For more facts about the Life-Line "A," call your local Westinghouse representative . . . or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-22034-R

YOU CAN BE SURE... IF IT'S Westinghouse



←

Unretouched photo of Life-Line "A" three-hp motor driving chemical pump at 1730 rpm, 100 gpm at Ohio-Apex.

"Westinghouse Life-Line "A" motors have cut our motor costs substantially . . . helped us keep our chemicals moving down the line," says Mr. Fitch of Ohio-Apex. "Their built-in ruggedness, plus foolproof sealing against corrosion, means longer life, lower maintenance."

In Iron Body Wedge Gate Valves,
Outside Screw and Yoke Design,

Walworth offers you these 8 outstanding advantages!

STRONGER CONNECTIONS. T-head disc-to-stem connection on OS&Y types permits wedge to properly seat itself.

TIGHTER SEAL. Solid web type disc on OS&Y valves provides tight closure, greater strength and longer service.

REDUCED TURBULENCE. Fluid action is minimized due to this straight-flow port design.

FEWER OBSTRUCTIONS. Seat rings of bottom-seated types are screwed into body to prevent gum and grit accumulations.

Walworth Subsidiaries: ALLOY STEEL PRODUCTS CO. · CONOFLOW CORPORATION · GROVE VALVE AND REGULATOR CO.

SURE-GRIP HANDWHEEL. Fluted design assures a sure grip, even with greasy gloves.

HIGH CORROSION RESISTANCE. Brass liner protects glands from deterioration and scoring.

EASIER REPACKING. Hinged gland eye-bolts on OS&Y valves permit fast maintenance under full pressure.

LESS DAMAGE. Bronze back-seat bushing in bonnet of OS&Y valves prevents scoring, guides stem accurately

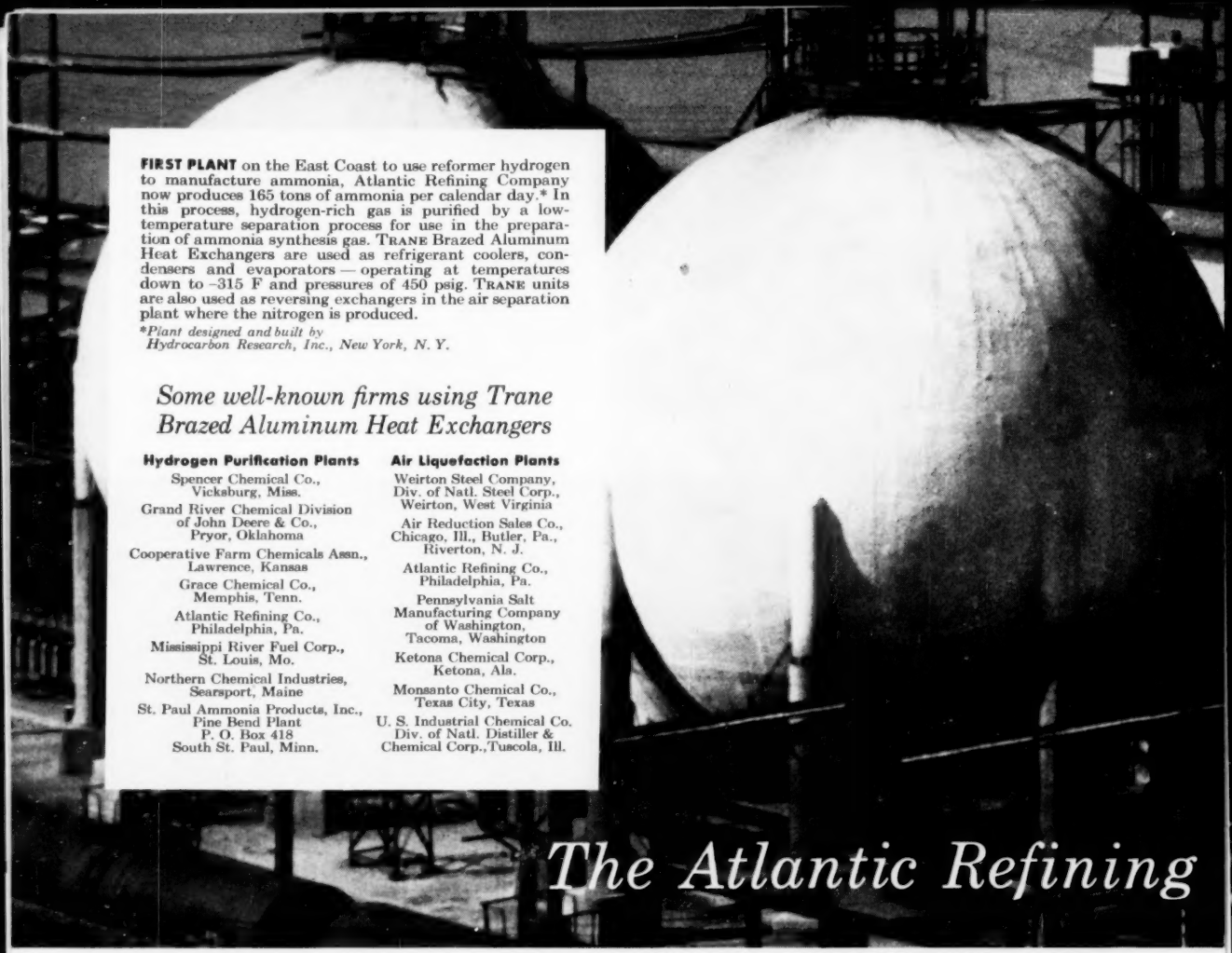
Walworth Iron Body Gate Valves are available with screwed or flanged ends, in sizes and types for every purpose.
For full information see your Walworth Distributor or write:
Walworth Company, ***750 Third Avenue,*** *New York 17, N. Y.*

WALWORTH*

*WALWORTH is a registered trademark of WALWORTH COMPANY

DISTRIBUTORS IN PRINCIPAL CITIES THROUGHOUT THE WORLD

M & H VALVE & FITTINGS CO. · SOUTHWEST FABRICATING AND WELDING CO., INC. · WALWORTH COMPANY OF CANADA, LTD.



FIRST PLANT on the East Coast to use reformer hydrogen to manufacture ammonia, Atlantic Refining Company now produces 165 tons of ammonia per calendar day.* In this process, hydrogen-rich gas is purified by a low-temperature separation process for use in the preparation of ammonia synthesis gas. TRANE Brazed Aluminum Heat Exchangers are used as refrigerant coolers, condensers and evaporators — operating at temperatures down to –315 F and pressures of 450 psig. TRANE units are also used as reversing exchangers in the air separation plant where the nitrogen is produced.

**Plant designed and built by Hydrocarbon Research, Inc., New York, N. Y.*

Some well-known firms using Trane Brazed Aluminum Heat Exchangers

Hydrogen Purification Plants

Spencer Chemical Co., Vicksburg, Miss.

Grand River Chemical Division of John Deere & Co., Pryor, Oklahoma

Cooperative Farm Chemicals Assn., Lawrence, Kansas

Grace Chemical Co., Memphis, Tenn.

Atlantic Refining Co., Philadelphia, Pa.

Mississippi River Fuel Corp., St. Louis, Mo.

Northern Chemical Industries, Searsport, Maine

St. Paul Ammonia Products, Inc., Pine Bend Plant P. O. Box 418 South St. Paul, Minn.

Air Liquefaction Plants

Weirton Steel Company, Div. of Natl. Steel Corp., Weirton, West Virginia

Air Reduction Sales Co., Chicago, Ill., Butler, Pa., Riverton, N. J.

Atlantic Refining Co., Philadelphia, Pa.

Pennsylvania Salt Manufacturing Company of Washington, Tacoma, Washington

Ketona Chemical Corp., Ketona, Ala.

Monsanto Chemical Co., Texas City, Texas

U. S. Industrial Chemical Co. Div. of Natl. Distiller & Chemical Corp.,Tuscola, Ill.

450 psig operating Trane Brazed Aluminum

Flexibility, compactness, close temperature control aid economical production of high purity ammonia

ANHYDROUS AMMONIA, 99.99% pure, containing no more than .01% water, has been produced at Atlantic Refining Company's plant at Philadelphia, Pennsylvania since July, 1954.

Plant efficiency and quality of the product are improved by the use of fifty TRANE Brazed Aluminum Heat Exchangers in the cold box—an important part of the processing operation.

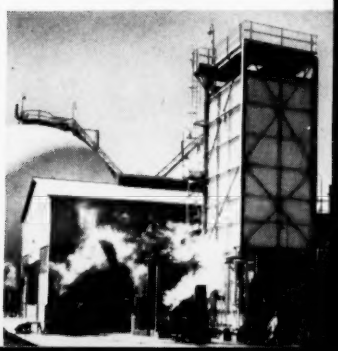
These TRANE Exchangers are especially well suited for the complicated heat transfer operations necessary in the purification of the nitrogen and hydrogen. In the process, temperatures go as low as –315 F—with operating pressures up to 450 psig. TRANE Brazed Aluminum Heat Exchangers can be used for design pressures as high as 600 psig. High heat transfer rate permits temperature approaches as close as 5 F, thus reducing refrigeration power costs.

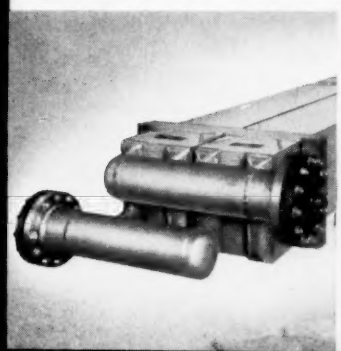
More and more modern low temperature gas separation plants are relying on TRANE Brazed Aluminum Heat Exchangers. Lightweight, compact and efficient, these Exchangers help reduce costs, while maintaining high production standards. If you have a heat transfer problem involving low temperatures, multi-stream operation or close approaches, turn to TRANE! Ask your nearby TRANE Sales Office, or write direct to TRANE, La Crosse, Wisconsin.

pressure at -315 F...with Heat Exchangers!

COLD BOX contains more than fifty TRANE Heat Exchangers. These lightweight exchangers consist essentially of alternate layers of corrugated aluminum sheets between flat plates, making it possible to obtain low temperatures with an economical minimum of equipment.

FLEXIBILITY OF TRANE Exchangers makes it possible to handle several streams simultaneously in one exchanger unit. Either individual cores or multi-core assemblies may be headered for multi-stream operation, combining as many as four different heat exchangers in one unit.





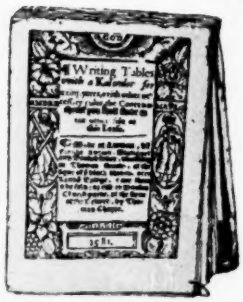
For any air condition, turn to

TRANE

MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS. • SCRANTON MFG. DIV., SCRANTON, PA. • TRANE COMPANY OF CANADA, LTD., TORONTO
96 U.S. AND 19 CANADIAN OFFICES

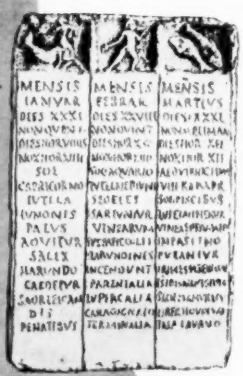
Scandinavian Calendar – Between 8th and 14th Centuries



English Tables – 16th Century

Operating time of Clark Centrifugals

Roman Farmer's Almanac – 1st Century A. D.



Aztec Calendar Wheel – Before 1479

Saxon Calendar – About 8th Century

totals 19 CENTURIES

Operating experience recorded by Clark centrifugal compressors totals 1,981 years. Providing rugged, reliable service 'round the clock, they have compiled this lengthy performance record within the actual time of only 10 years.

When Clark began to build centrifugal compressors a decade ago, pressures of 100 psi. were not considered practical. Today, as a result of Clark advanced engineering and design, Clark centrifugals are operating at over 5,000 psi. From the first, they have proved themselves in the field.

Clark builds two basic types of centrifugals. The horizontally split case type is designed for low to moderately high pressure ranges. The vertically split case type is used for extremely high pressure conditions. With capacities ranging from 1,000 to more than 150,000 CFM., Clark centrifugals are being used in new and ever widening applications throughout the world.

For all the facts about these performance-proved compressors backed by Clark's *encyclopedia of experience*, call your nearby Clark engineer. Or write today for Bulletin 150 to Clark Bros. Co., 1803 Lincoln Avenue, Olean, New York.

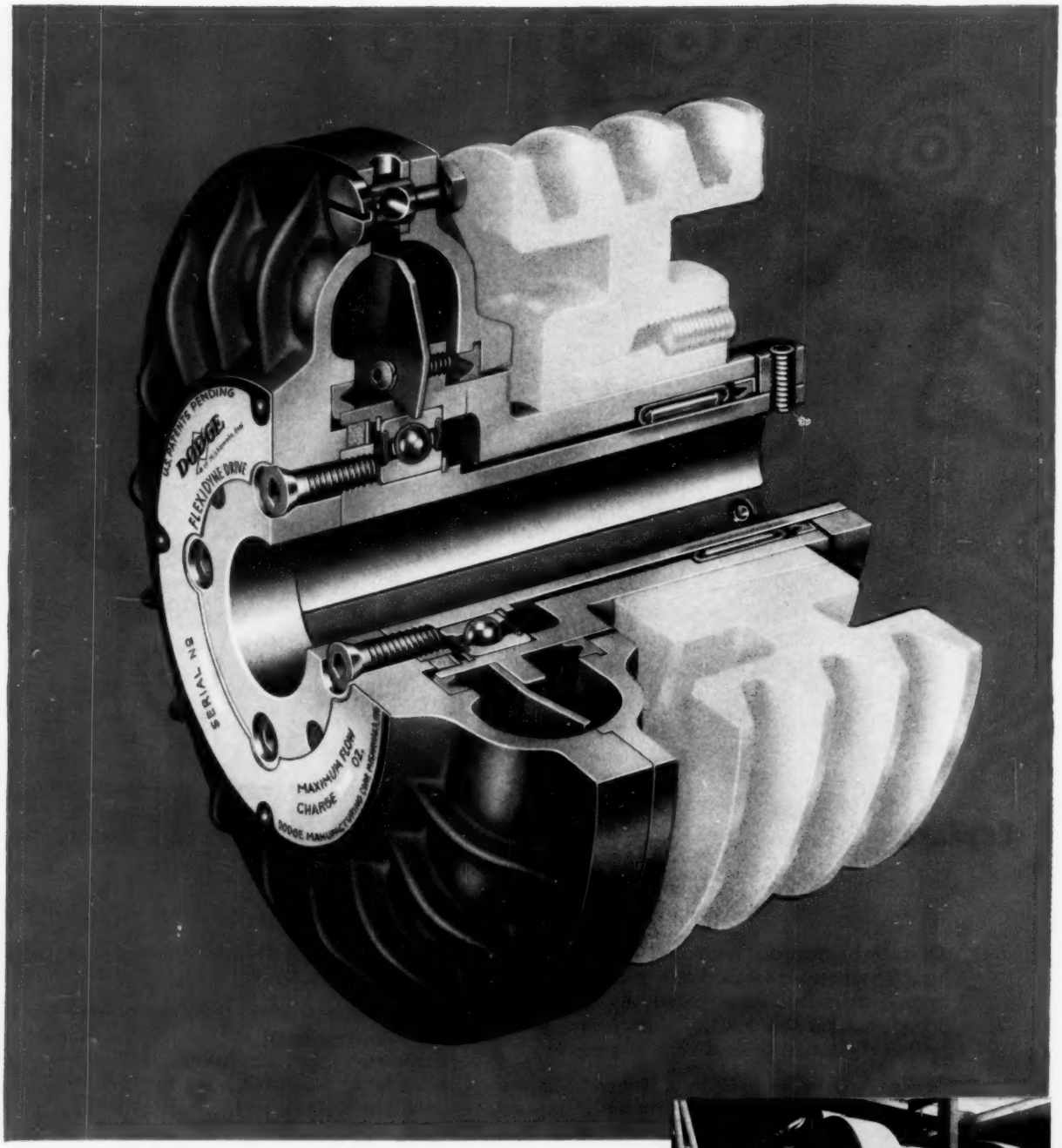
CLARK BROS. CO.

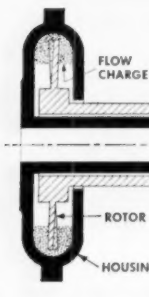
One of the Dresser Industries

Sales and service outlets in principal cities throughout the world

CLARK® — ONE OF THE DRESSER INDUSTRIES

CENTRIFUGAL COMPRESSORS

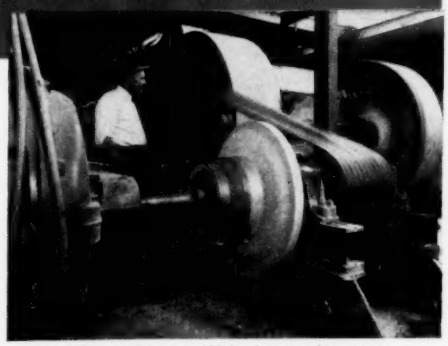




HOW FLEXIDYNE WORKS

The "dry fluid" in Flexidyne is tiny heat-treated steel shot. A measured amount, called the "flow charge," is contained in the housing, which is keyed to the motor shaft. Inside the housing is a rotor, free to revolve relative to the housing, but connected to the load.

When the motor is started, centrifugal force throws the flow charge to the perimeter of the housing, packing it between the housing and the rotor, which transmits power to the load. Initial slippage is momentary. Housing and rotor become locked together and achieve full load speed without slip and at 100% efficiency.



Overloads on a 150 hp jaw crusher cause sudden damage. Here Flexidyne is used to minimize this costly trouble. As a bonus, it reduces belt wear and replacement.

Working with Hastelloy is a Talent at..

Vulcan manufacturing

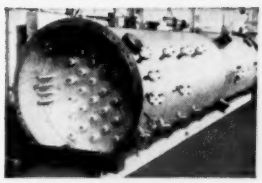
Because Hastelloy offers such a high degree of corrosion resistance, it's a natural choice for many applications in today's chemical processes. However, like many special alloys, it calls for unusual care and expertness in fabrication.

In the application illustrated at the left, Vulcan Manufacturing lined a carbon steel kettle with nearly four tons of Hastelloy C. This job required not only safeguards against cracking but full protection against carbon steel pick-up as well.

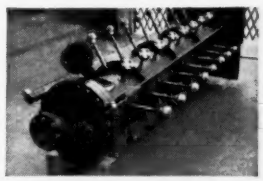
In successfully producing this Hastelloy-lined still kettle, Vulcan has again demonstrated a talent to handle the specialized jobs that are more and more becoming a part of today's process equipment.

When your plans call for dependable know-how in fabricating key components for chemical processes, remember Vulcan Manufacturing. For here's a talent that manifests itself in black ink – which we think is the real end product you look for.

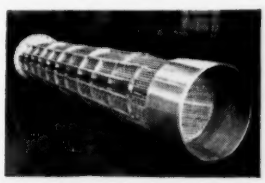
For further information call or write:



Stainless steel...
Was used in this instance to fabricate a bubble cap tower



Monel...
Another special alloy was employed in the manufacture of this complex reactor

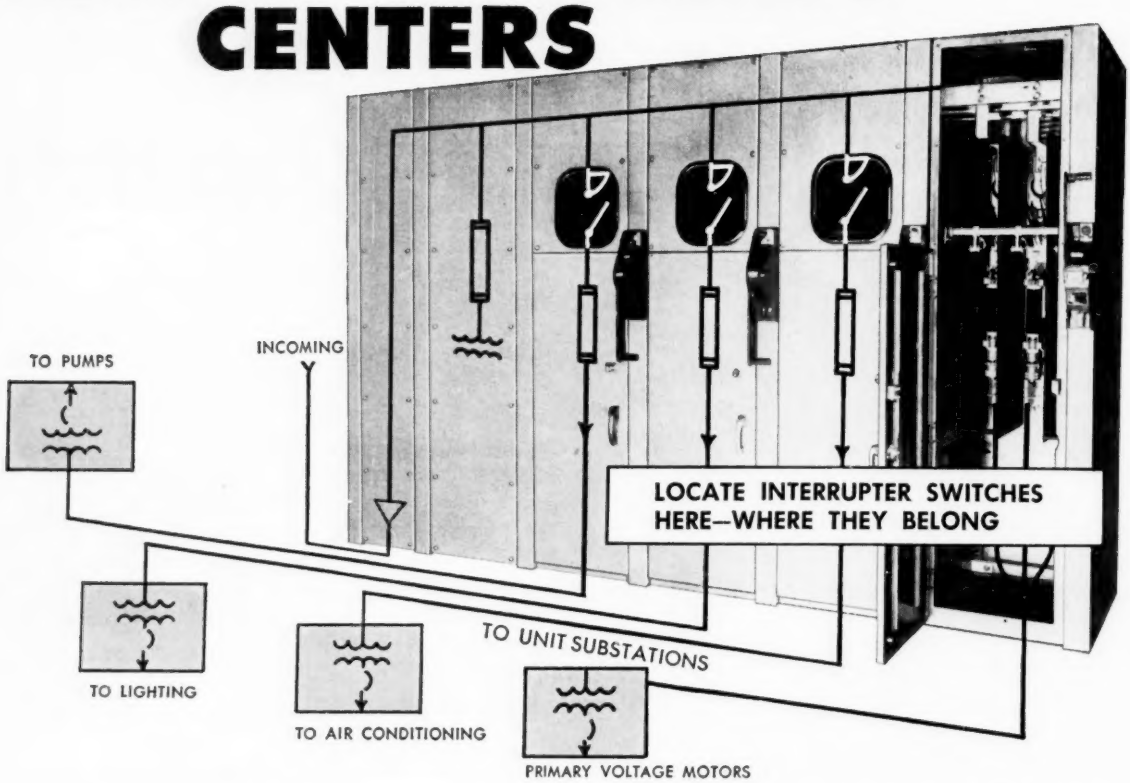


Aluminum too!
Shell and tube type heat exchanger bundle made of lightweight aluminum

Vulcan manufacturing

120 Sycamore Street, Cincinnati 2, Ohio, Dunbar 1-1400 Designers and builders of process equipment

R&IE POWER SWITCHING CENTERS



Cost Less *Save Space* *Easier to Maintain*

Safe —with the HPL-C interrupter switch—because it will close in on moderate faults.

SAFE CLOSING RATINGS

Asymmetrical 3-phase Kva values:

Nom. Voltage	Direct or Chain Drive	TOG-L SNAP, non-current limit fuses	TOG-L SNAP, current limit fuses
2,400	50,000	150,000	250,000
4,800	75,000	250,000	500,000
7,200	75,000	250,000	750,000
12,000	75,000	250,000	1,000,000
13,800	75,000	250,000	1,000,000

Always specify TOG-L SNAP operating mechanism for maximum safety. Available as optional feature.

PSC HIGH VOLTAGE CUBICLES, standard design, indoor or outdoor, offer both efficiency and economy.

SAVE FIRST COST—Standardized, low-cost PSC cubicles with HPL-C fused interrupters, feature sectional main bus—providing compact flexibility. PSC means lower cost per feeder than scattered locations of switches in unit substations.

SAVE SPACE—With dry type load center transformers, PSC can save many square feet of floor space at the unit substation location. They also may be mounted overhead, saving additional floor space.

EASIER TO MAINTAIN—Easily operated, accessible for inspection. Can be handled with any maintenance crew.

PROTECT SYSTEM—Against faults in cables as well as transformers.

ADD FEEDERS any time—up to 1200 Amp. total load.

Ask your I-T-E Representative to show you the many PSC economies. Data available.

R&IE

R&IE EQUIPMENT DIVISION
I-T-E CIRCUIT BREAKER CO.
GREENSBURG, PA.

PSC - 3

Your Eye Can See What Performance Records Prove

LUNKENHEIMER LUNCOR® PVC CUTS MAINTENANCE

Before Luncor, corrosive service required expensive high-alloy installations. Now, the very ruggedness and dependability you see in the unretouched photo, below, has been put to work in hundreds of corrosive applications to bring about low initial costs, lower maintenance costs.

Luncor is the first PVC valve designed and engineered by a valve manufacturer. Its maintenance-free performance has been proved in corrosive services in:

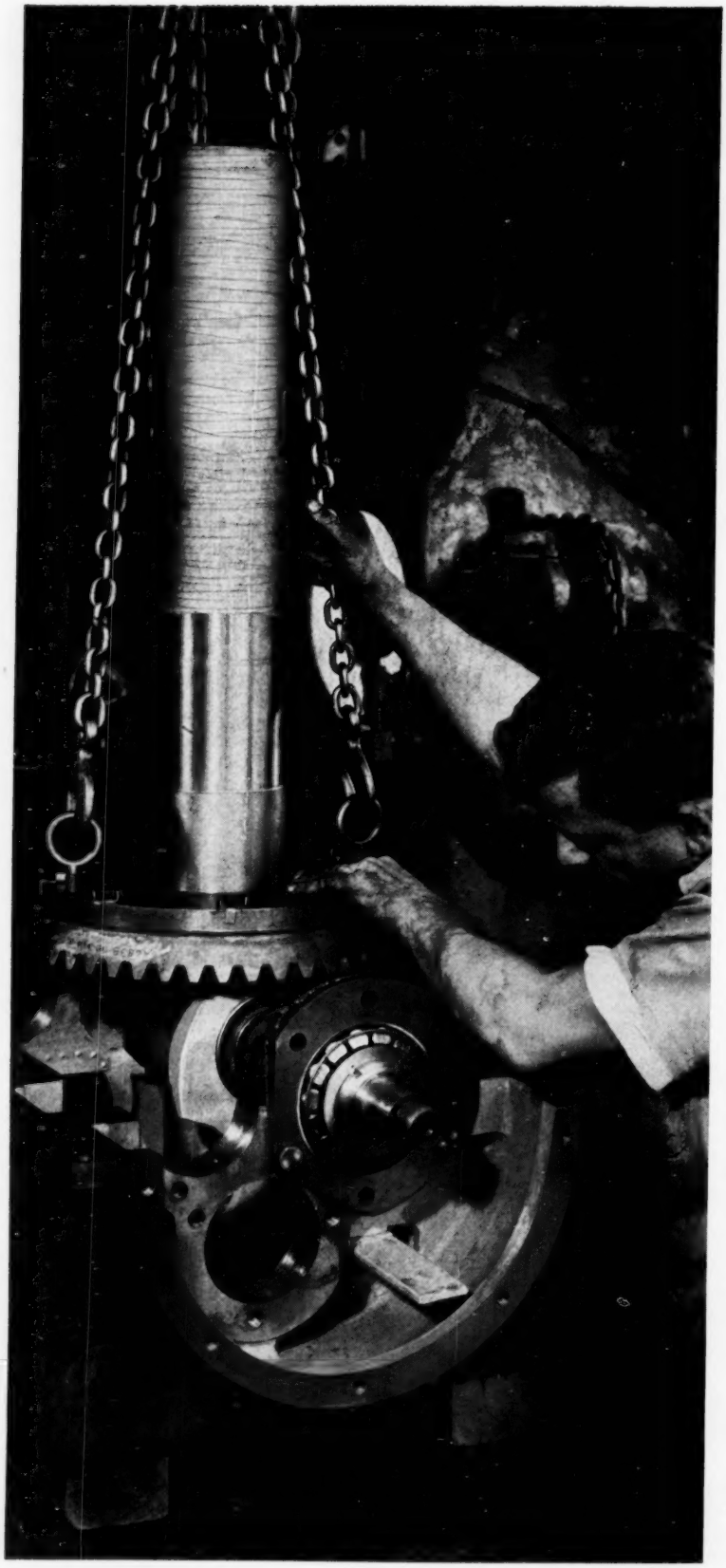
- PAPER MILLS
- CHEMICAL PLANTS
- FOOD PROCESSING
- BEVERAGE BOTTLING
- PETROLEUM REFINING
- SUGAR REFINING
- WATER TREATMENT
- MARINE INSTALLATIONS

Let your Lunkenheimer Distributor show you the money-saving, high-performance benefits of Luncor PVC Valves. For service recommendations, ask him for a Confidential Corrosion Service Form. Or write: The Lunkenheimer Company, Cincinnati 14, Ohio.

Fig. 2600 Screwed End
Fig. 2601 Socket End
125 lb. W. O. G. 140°F.
Sizes ½ to 2-inch

LUNKENHEIMER QUALITY

LUNKENHEIMER®
THE ONE *Great* NAME IN VALVES



YOU GET MORE FOR YOUR FLUID MIXER DOLLAR

because we design and build the whole unit

It's simple economics! Philadelphia Mixer is the *only* manufacturer that designs and builds the complete unit—mixer drive, shafting, impeller and coupling. Because *we* control production and costs, we can *afford* to give you more mixer per dollar. For example:

- Extra large, heavy duty bearings throughout.
- Extremely heavy output shafting—machined, ground and polished.
- Drives designed with extra strength and rigidity to take maximum thrust and unbalanced loads.
- Quick-change gear sets for 14 standard speeds.

You don't pay a premium price for these extras—or for the better performance, longer life, lower maintenance. You get them as a *bonus* when you buy from Philadelphia Mixer . . . the only source that maintains completely integrated facilities for mixer design, application engineering, manufacturing and field service.

You can select your Philadelphia Mixer from six standard models. One to 200 hp. Special units available to 500 hp. Horizontal or vertical motor. Mechanical seal or packed stuffing box. Paddle or turbine type impellers. If you have had no direct experience with Philadelphia Mixers, we urge you to consult those who have. We'll be glad to help you.

Get the full story on Philadelphia Mixers. Write for Catalog A-27. It contains complete mechanical design information that permits you to make a catalog selection of the unit that best suits your requirements. Philadelphia Gear Works, Erie Ave. and G Street, Philadelphia 34, Pa.

philadelphia mixers

Offices in Principal Cities

M-S-A (LIRA) Infrared Analyzer (Model 200)

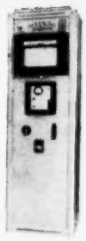
Low-cost deflection type unit for automatic, continuous, high speed, accurate analysis. Detects one component in a simple or complex mixture of gases or liquids. Unitized construction makes maintenance easy. All controls readily accessible on front panel. Write for details.

M-S-A Carbon Monoxide Analyzer

Single or multipoint cabinets designed as alarms or recorders are available for detecting or measuring low concentrations of carbon monoxide in air. Measurements are based upon measurement of heat of oxidation when sample is drawn through granular catalyst. Write for details.

M-S-A Combustible Gas Analyzer

Adaptable for use with any gas or vapor of which the explosive range, and molecular weight are known. Applications extend to all industries where combustible fluids are employed. Now available with remote filament heads specifically adapted to high temperature applications. Write for details.

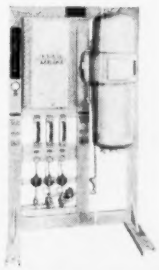


M-S-A Gas Thermatron

Simultaneously uses thermal conduction and thermal convection to provide simple, accurate, physical measurement of a single component in a complex mixture of gases without interference from other constituents. Can be used in many gas mixtures. Write for details.

M-S-A Oxygen Indicator

For precise, continuous measurement of oxygen content of inert and combustible atmospheres in chemical, metallurgical and petroleum industries. Provides means for improving safety of utility operations and controlling pipeline corrosion. Write for details.



M-S-A Water Vapor Recorder

Detects trace moisture in air or gas streams. Operation is based on measurement of the heat energy exchanged when a gas is adsorbed on or desorbed from the surface of a solid adsorbent. Can be calibrated for various ranges from 0 to 10 parts per million up to several percent. Write for details.

This line-up of M-S-A® Gas Analyzers can help solve your process stream problems

M-S-A Gas Analyzers have earned a sound reputation for on-stream accuracy and dependability while solving a myriad of complex control problems. Chances are, some of the problems confronting you now have already been solved for others, with one of the basic units described above.

The experience and service we can bring into play may provide the breakthrough you're looking for in successful process stream control. Our thirty years in the business of gas analysis instrumentation are worthy of your consideration. Get in touch with an MSA Instrument Specialist for details, or write for helpful literature.

MSA

INSTRUMENT DIVISION

MINE SAFETY APPLIANCES COMPANY

Pittsburgh 8, Pennsylvania

At your service: 76 Branch Offices in the United States

See what these NEW filters can do!

- **Economical recovery of valuable material.**
- **Simplified disposal of filter cake.**
- **Choice of power openings.**
- **Rapid self-cleaning devices.**
- **Complete automation or push-button control for all filtering and cleaning actions.**

If you think cleaning filters is a messy, costly job . . . take a good look at one of the new Industrial Vertical Filters.

The dirty work of cleaning has been changed to a push button routine with self-cleaning features like air wash, sluicing devices, mechanical shakers and something that has been needed for years . . . *cake discharge outlets where you need them!*

Industrial can help you organize a filtration system that fits your process like a hand in a glove. You can quickly recover or dispose of filter cake in wet, semi-solid or dry form. Filters can be made completely automatic or with any degree of manual control desired. Arranged in pairs or series, they eliminate down time or pressure drop in continuous processing. They are available with corrosion resistant linings or temperature insulation jackets.

Why not look into the advantages of modern filtration for your process? Analyses and recommendations by Industrial cost nothing...but can lead to better product quality and more economical processing. Write or call Industrial to see a qualified representative.

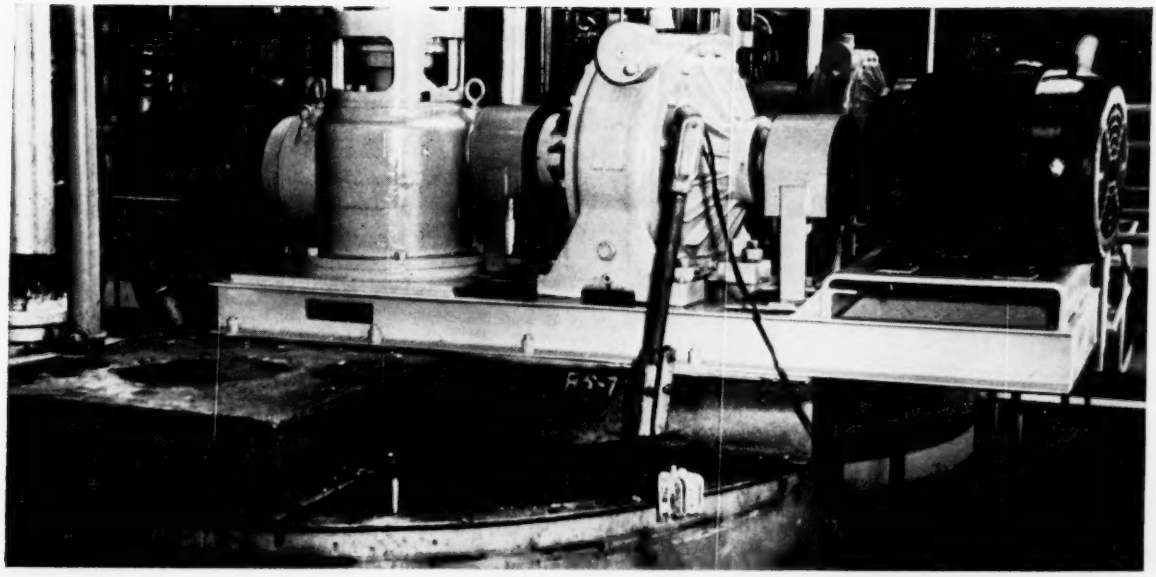
For more details on Industrial Filters, ask for Bulletin 111

Industrial

INDUSTRIAL

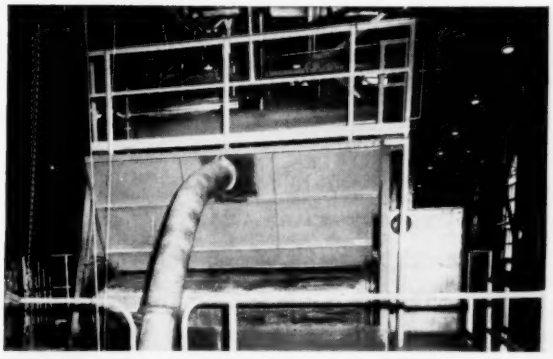
FILTER & PUMP MFG. COMPANY

5910 OGDEN AVENUE • CHICAGO 50, ILL.



From Coagulators to Dryers . . .
Stainless Steel Protects Copolymer Purity

Type 316L stainless used extensively in Phillips Chemical Company plant to prevent contamination, minimize corrosion.



This plant produces a high quality copolymer (Philprene synthetic rubber). To insure the purity achieved by careful processing, all tanks, agitators, troughs, filters and dryers are made of Type 316L stainless steel. Even the structural supports for mixing equipment are Type 316 to eliminate a potential source of corrosion and contamination.

PROFIT WITH STAINLESS

Why not profit with the multiple advantages of Armco Stainless Steels in the equipment *you* make or use. Armco produces a complete line of standard chromium and chromium-nickel grades, as well as many special stainless steels that provide high strength at elevated temperatures and improved resistance to oxidation and corrosion. For more information call your Armco Stainless Distributor or fill out and mail the coupon.

Armco Steel Corporation
1798 Curtis Street, Middletown, Ohio

Send me information on
☐ Armco ELC Stainless Steels
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NAME_____

COMPANY_____

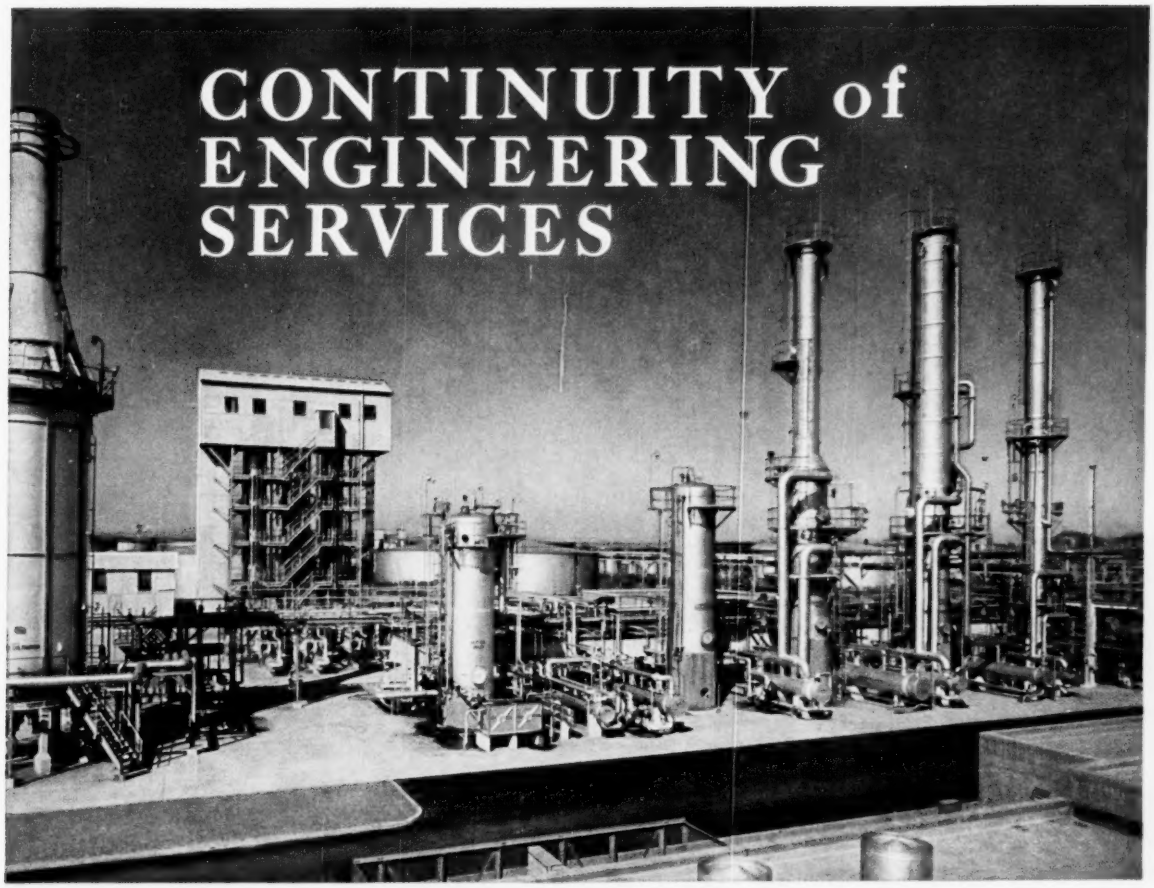
STREET_____

CITY_____ ZONE____ STATE_____

ARMCO STEEL

ARMCO STEEL CORPORATION • 1798 CURTIS STREET, MIDDLETOWN, OHIO

SHEFFIELD DIVISION • ARMCO DRAINAGE & METAL PRODUCTS, INC. • THE ARMCO INTERNATIONAL CORPORATION



BRITISH HYDROCARBON CHEMICALS LIMITED recently placed in operation a Tetramer Plant employing the U.O.P. Process at their Grangemouth, Scotland chemical complex.

Stone & Webster Engineering Corporation, together with its affiliate E. B. Badger & Sons Limited engineered and constructed the new plant as well as the existing facilities for the production of Ethylene, Ethanol, Isopropanol and Detergent Alkylate. Work is now in progress on Polyethylene and Cumene-Phenol Plants.

The charge stock for the Tetramer Plant is propylene from the two existing Ethylene Plants. Part of the capacity of the new plant is used as a charge stock for the Detergent Alkylate Plant.

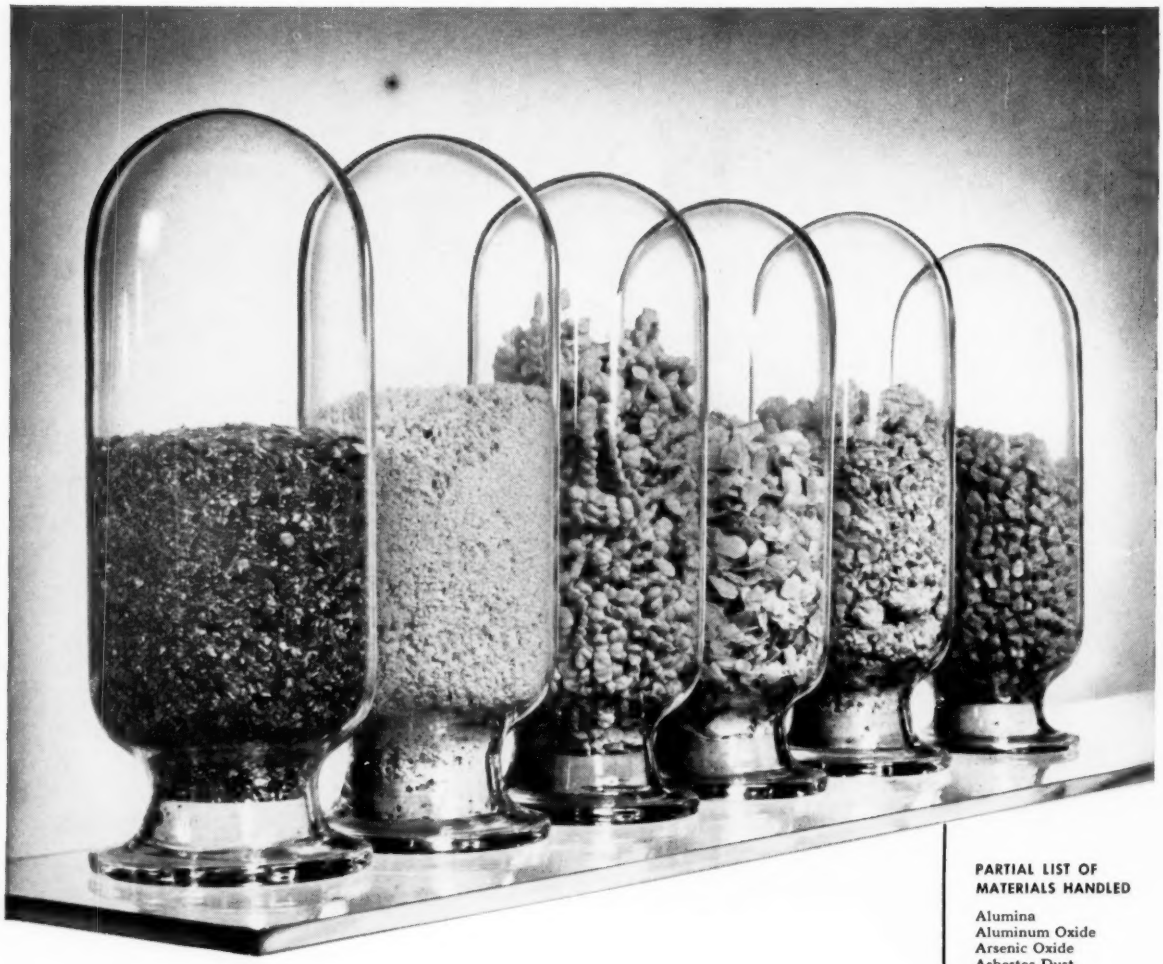
Stone & Webster Engineering Corporation's world-wide experience and client confidence, typified by its long association with British Hydrocarbon Chemicals Limited, is at your disposal.

Write or call us for information as to how our experience may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

AFFILIATED WITH E. B. BADGER & SONS LIMITED (LONDON)

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Seattle Toronto



THESE MATERIALS FLOW THROUGH THE AIR

...with the greatest of ease

Today, more and more industrial plants are turning to Fuller to solve their problems in handling a wide range of dry bulk materials. Fuller pneumatic conveying systems have gained such wide acceptance within industry because Fuller has engineered its equipment for "automated" operation.

When you have a Fuller system, you can save thousands of dollars by buying in bulk rather than in bags. There is no waste in handling. The most stringent sanitation requirements can be met.

Efficient, peak production is assured and at far lower operating costs than many other types of conveying systems, and your maintenance problems are at the minimum. Why not write to Fuller Company today—we'll be glad to send you descriptive literature showing you how Fuller solves many different problems in many types of plants.

PARTIAL LIST OF MATERIALS HANDLED

Alumina
Aluminum Oxide
Arsenic Oxide
Asbestos Dust
Barite
Bauxite
Bentonite
Borax
Calcium Carbonate
Carbon Black
Catalysts, Petroleum
Cement, Portland
Cement Raw Material
Chalk
Clays
Coal, pulverized
Detergent Powders
Diatomaceous Earth
Feeds, soft
Fertilizers
Flour
Flue Dusts
Fly Ash
Gypsum (raw or calcined)
Lime, pulverized
Malt
Ores, pulverized
Phosphate Rock, pulverized
Resins, synthetic
Salt
Silica, pulverized
Starches
Sugars, refined
Talc

Fuller
. . . pioneers in harnessing AIR

FULLER COMPANY
GENERAL AMERICAN

FULLER COMPANY
134 Bridge St., Catasauqua, Pa.

SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION

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G-151
3756

Why bother with unreliable water supplies?

Get fresh water from the sea...trouble-free ...with Cleaver-Brooks Flash Evaporators

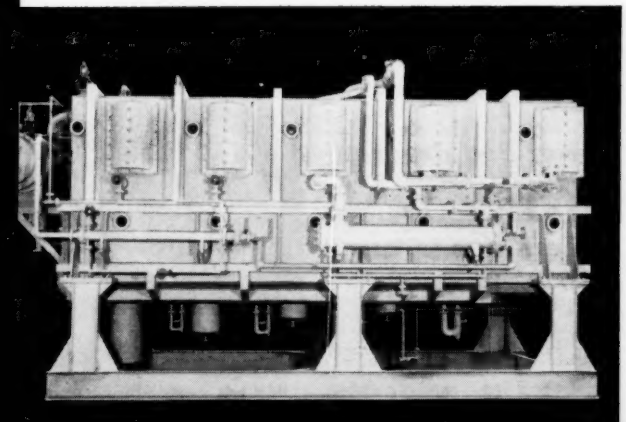
Where sea water is the only source of water, Cleaver-Brooks Flash Evaporators are the economical and dependable answer to fresh water problems. Cleaver-Brooks units produce volumes of pure, fresh water from the sea . . . 24 hours a day, month after month . . . no worries about delivery schedules or pipe line failures.

Cleaver-Brooks Flash Evaporators' dependable performance is made possible by an advanced engineering principle . . . flash evaporators literally flash water into steam. No boiling on heat transfer surfaces, no scale or sludge cleaning problems. The result: Low maintenance costs, little downtime. Automatic principles give you further savings on operating costs.

Whatever your fresh water needs, 10,000 gallons per day, 500,000 gallons or more, it will pay you to investigate Cleaver-Brooks Flash Evaporators.

Trouble-free Cleaver-Brooks Flash Evaporators produce pure water more economically than you ever thought possible.

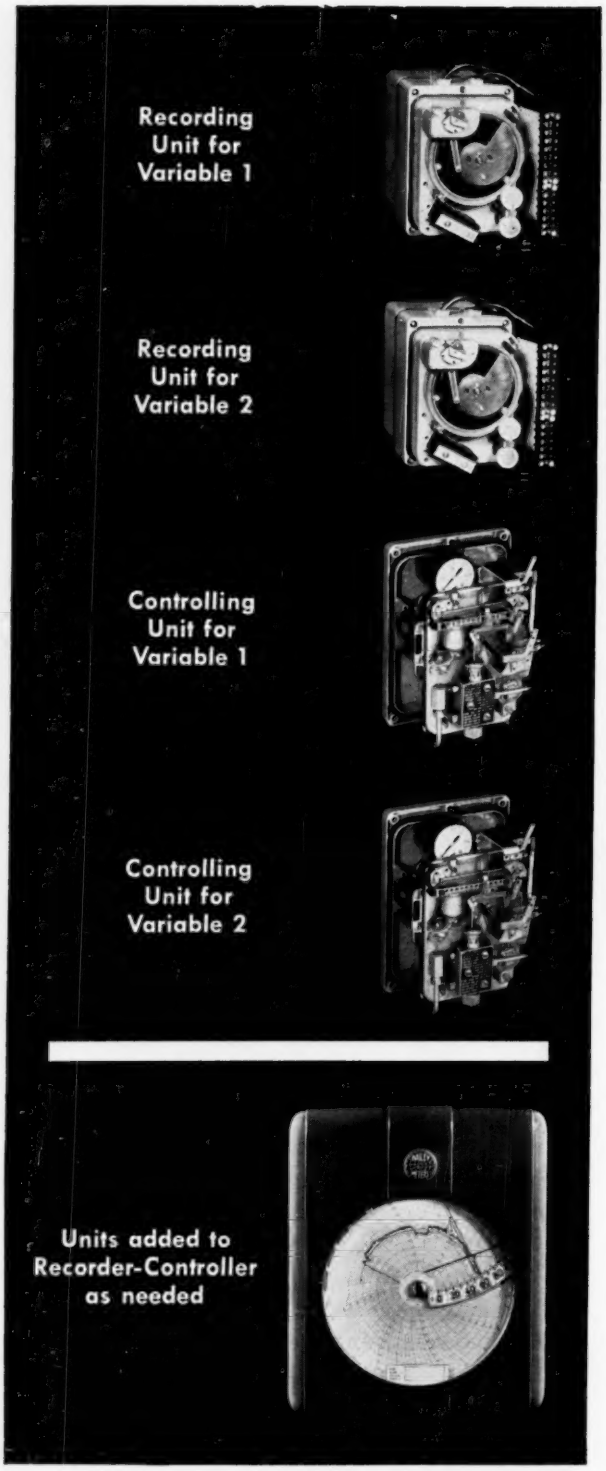
For more information and specifications write to Cleaver-Brooks Company, Special Products Division, 225 Grand Ave., Waukesha, Wisconsin, Dept. CE48.



Cleaver-Brooks Flash Evaporators such as the one pictured here will soon be in service in two South American communities, each supplying 50,000 gallons of water per day. Thousands of other Cleaver-Brooks evaporators have been and are producing fresh water in 22 other countries . . . all over the world.

Cleaver Brooks®

BUILDERS OF EQUIPMENT FOR THE GENERATION AND UTILIZATION OF HEAT



Bailey Recorder is key to "step-by-step" automation

When you are pioneering a new process and don't know all the answers, complete automation is seldom practical. The first step is to identify your variables and measure them. Nothing does this job better than a Bailey Recorder. One instrument can record any four variables that can be converted to electric *or* pneumatic signals.

Once you get a better understanding of the variables in your process, you will want to add controls and feed back your measurements. Here's where the versatility of the Bailey Recorder comes into play. For the same Bailey instrument you use to record variables is designed to accommodate plug-in control units.

When you use a Bailey Recorder, you can build your instrumentation along with your process. At the start, you use only the plug-in units for recording. Then you add plug-in controls as you see the need for them.

For the complete story of how you can use a Bailey Recorder for step-by-step automation, see your Bailey Engineer. G-42-1

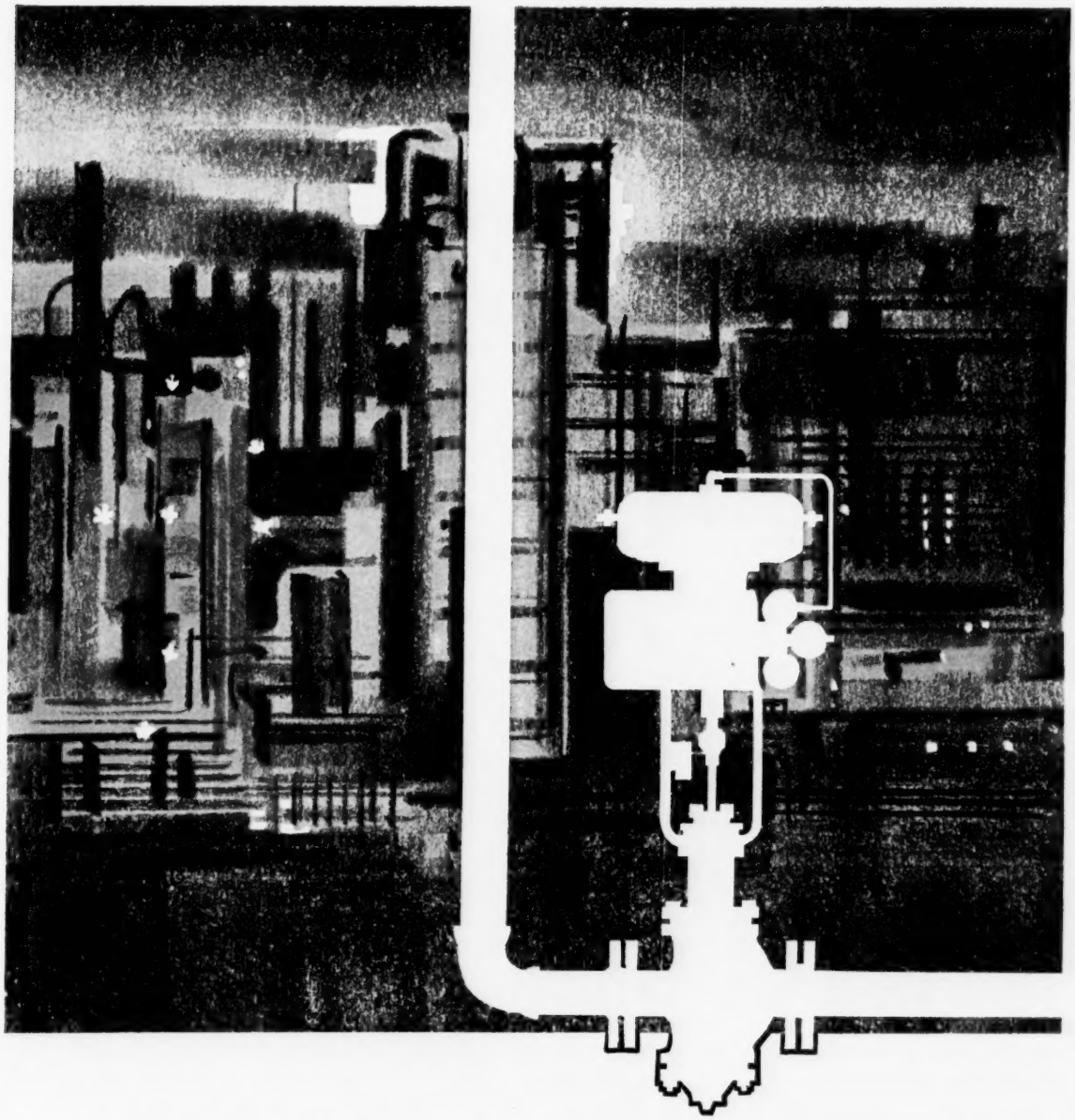
Instruments and controls for power and process

BAILEY METER COMPANY

1054 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

BAILEY METERS



...almost forgotten...because it does its job so well!

Dependable, year-after-year performance makes a Fisher Diaphragm Motor Valve the preferred control in the power and process industries. The Fisher D.M.V. has features not available on other brands. The extra thick steel casing, the precision finished valve stem, the large capacity and the trouble-free operation —these are just a few of the reasons a Fisher gets the nod when it comes to diaphragm motor valve selection.

If you want to know more about the ultimate in control—the Fisher Diaphragm Motor Valve —write for Bulletin E657A.

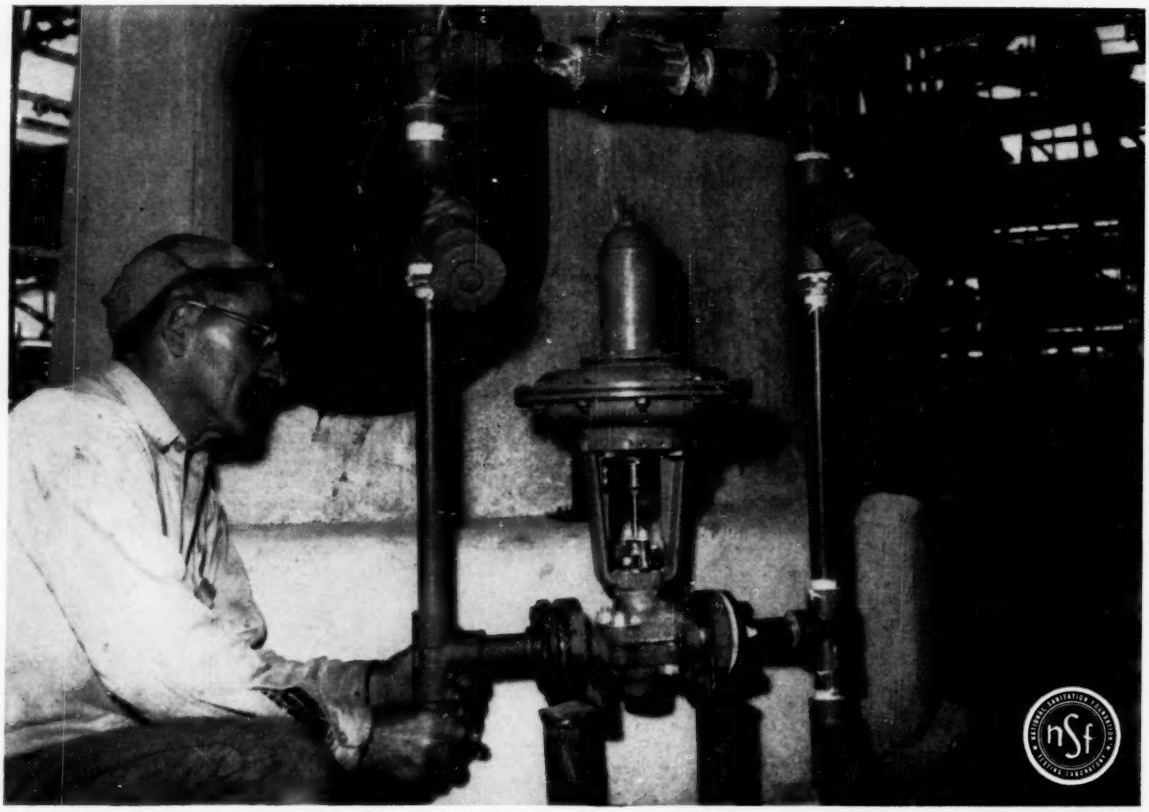
IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD... CHANCES ARE IT'S CONTROLLED BY...

FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / London, England

FISHER® Controls

SINCE 1880



Texaco Chemical Plant uses acid lines of USS National* PVC Pipe

A lube oil additive plant, recently constructed by Texaco at its Port Arthur, Texas refinery, employs 750 feet of normal-impact National Polyvinyl Chloride Pipe (Schedule 80). Over 500 feet of this PVC Pipe, in diameters of 1 inch and 1½ inches, is being used to handle a variety of mineral and organic acids involved in the lubricating oil additive production process.

Other National PVC Pipe, in diameters of 2 inches, 3 inches and 4 inches, carries waste water at 120°F from the glass-lined neutralizing tank. This water also contains acids and other by-products of the process. Additional smaller diameter lines of National PVC Pipe are employed as treating tower return lines, operating at ambient at 40 to 50 psi.

Tough, rigid, acid-resistant National PVC Pipe is available in sizes up to 14" O.D. and in Schedules A, 40, 80 and 120. It comes in two types:

Normal impact – for installations requiring the highest chemical resistance attainable, together with high strength and excellent creep resistance.

High impact–for installations requiring excellent chemical resistance and a high degree of toughness, even at low temperatures.

For further details, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pennsylvania. Ask for Bulletin No. 24.

*Trademark

The world's finest tubular products from the best-known name in pipe—National Tube.

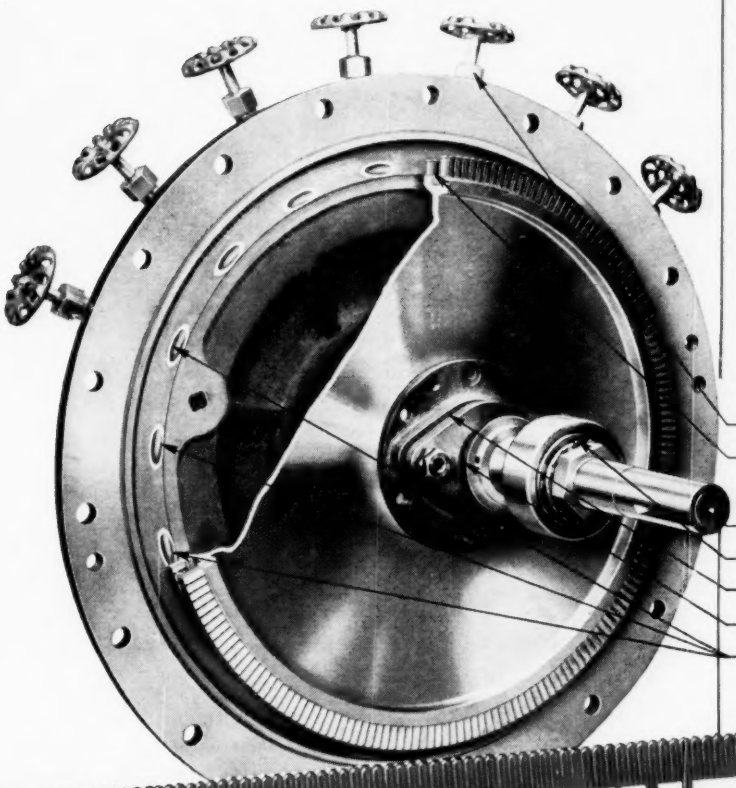
National Tube Division of USS United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • United States Steel Supply Division • United States Steel Export Company, New York

No other steam turbine offers you

SUCH VERSATILE STEAM NOZZLE CONTROL

The larger number of hand valves you see on a Coppus Steam Turbine promises you greater operating economy. At least 60% of the steam nozzles can be individually controlled to give maximum steam pressure in steam chest . . . a guarantee of best water rates at any load. Maintenance economy, too, is assured by the hard chromium plating of the shaft at the stuffing box. It provides the best possible smooth, non-corrosive surface for packing rings.



7 hand valves for efficient partial load operation, (20" turbine shown)

2 row velocity-stage turbine wheel with stainless steel turbine buckets — statically and dynamically balanced

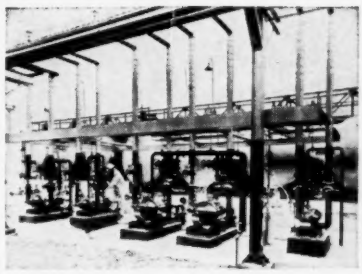
30-40 carbon steel shaft

Oversized double row deep grooved ball bearing

Stuffing box with metallic packing ring

Heavy chrome plating of shaft through stuffing box

3 nozzles always open



Coppus Steam Turbines, Type TF, driving chemical transfer pumps at Celanese Corporation of America's Chemcel Plant

Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes

MAKE TURBINE DOLLARS GO FARTHER

Why waste money buying turbines with higher horsepower ratings than you need? The higher the horsepower rating, the higher the price. Save money by selecting the Coppus Turbine size closest to your requirements from 150 hp down to fractional. And when you do, you save operating and maintenance costs, too. That's what these other Coppus features are designed to do: exclusive pilot operated excess speed safety trip supplementing constant speed governor; choice of metallic or carbon ring packing assemblies. Designs available for back pressures up to 75 pounds; replaceable cartridge type bearing housings. For full details . . .

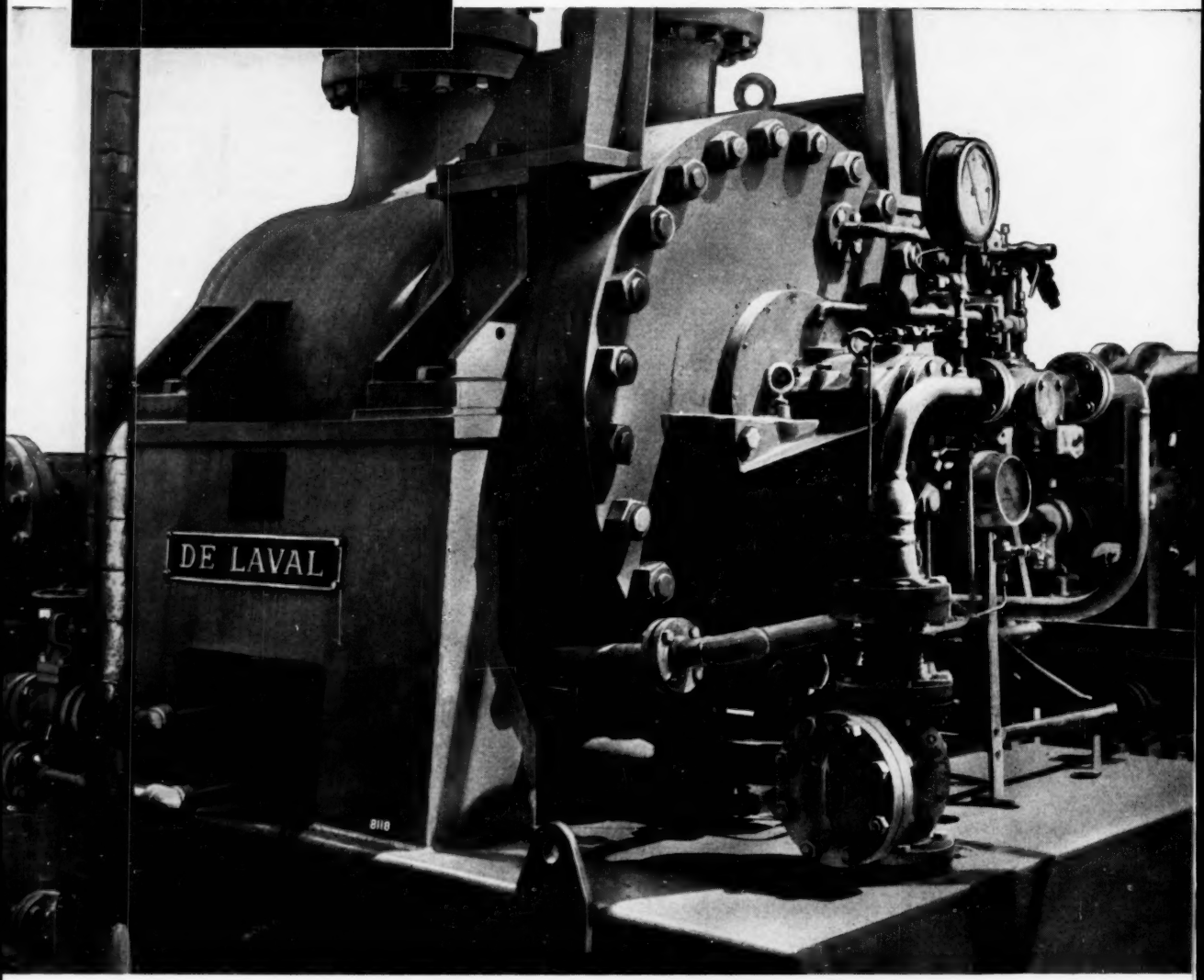
WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORP., 224 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

DE LAVAL
BARREL TYPE REFINERY COMPRESSOR

handles hydrogen under high pressures in a reformer at General Petroleum



Send for new Bulletin 0504

This De Laval centrifugal recycle barrel type compressor is doing a dependable job handling hydrogen under high pressures at the General Petroleum plant in Ferndale, Washington. It takes hydrogen at an inlet pressure of 500 psig and discharges it at 625 psig. The unit is driven by a 1110 hp turbine operating at 9900 rpm.

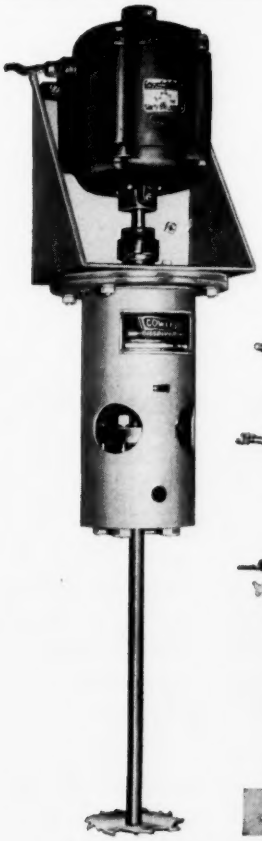
General Petroleum Corporation is only one of many refiners who have specified De Laval Compressors. Whether you need to handle light or heavy gases at high or low pressures in catalytic cracking, reforming, alkylation, coking or any similar service, it pays to look to De Laval. Rugged De Laval centrifugal compressors perform dependably in heavy-duty continuous operation. De Laval has more than 40 years of experience in solving gas compression problems.

DE LAVAL *Centrifugal Compressors*

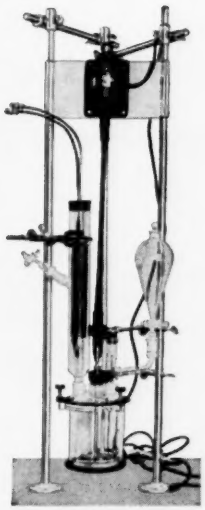
DE LAVAL STEAM TURBINE COMPANY
803 Nottingham Way, Trenton 2, New Jersey

DL-969

FOR EXOTIC FUELS...



Cowles Pilot-Plant Sodium Dispersion Dissolver



Cowles Laboratory Sodium Dispersion Dissolver

Metallic dispersions finished in 30 minutes or less, particle size as small as two microns, with Cowles Dissolvers.

Largest Manufacturers have selected Cowles equipment

Highest quality metallic dispersions can now be easily controlled and produced in big volume, making many reactions commercially practical for the first time.

Key to the new method is the unique action of the patented Cowles impeller. With rim speeds of up to 6150 fpm, the impeller vanes create a zone of intense turbulence and hydraulic shear. The liquid is moved rapidly through itself until maximum dispersion is obtained. The Cowles thus gives several many very important advantages:

Versatility — prepares material for many reactions under conditions not heretofore possible.

Finer particle size — gives maximum reaction surface to dispersed elements.

More complete dispersion — assures complete homogeneity of material.

Greater speed — cuts finished dispersion time substantially.

Cleanliness — self-cleaning impeller will not clog with metal.

Safety — gives the close control necessary with highly active materials.

Predictable results — laboratory and pilot-plant models provide results easily duplicated in larger models.

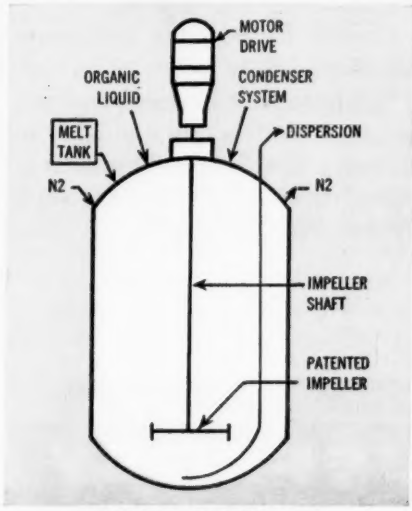
New Cowles Dissolvers with properly sealed and specially designed drives for metallic dispersions are available for all purposes. Included are "package" models in both laboratory and pilot plant types, and models for commercial production. All are thoroughly proven in actual plant operations and represent the broad experience and know-how of our organization – the established leader in its field. Specialized engineering assistance can be supplied if desired.

For complete information write today for Technical Bulletin No. 21-1957, "Metallic Dispersions with the Cowles Dissolver."

Additional Cowles Dissolver models are available for efficient processing of all solid-liquid, liquid-liquid and gas-liquid products.

Take advantage of the unusual *Morehouse-Cowles Processing Equipment Application Service* at no obligation – for a comprehensive survey of your plant requirements and end products, with laboratory assistance and in-plant tests at our risk.

5702-R



Schematic Plant Diagram

See us in Booth 423 Pacific Chemical Exposition—San Francisco, April 13-17.

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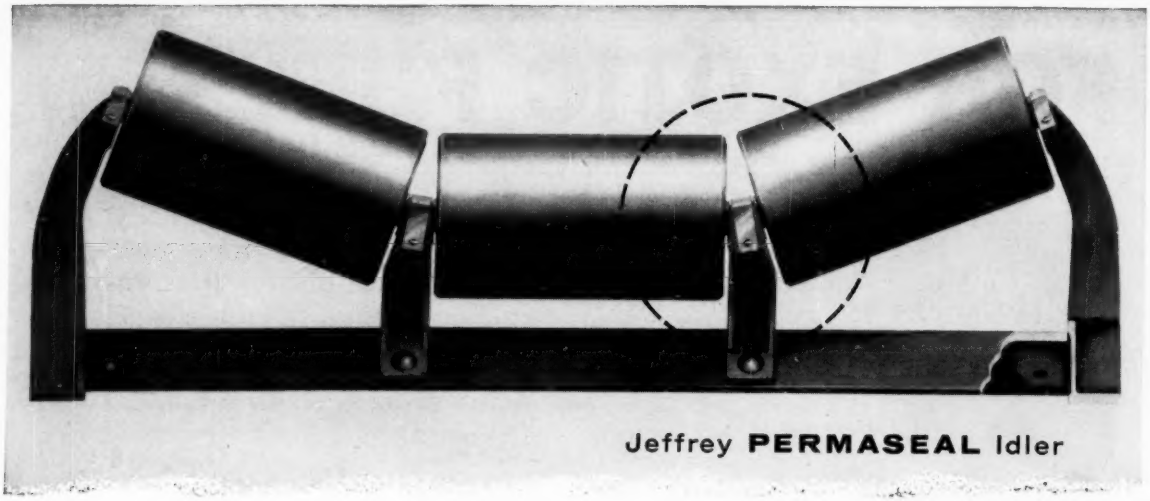
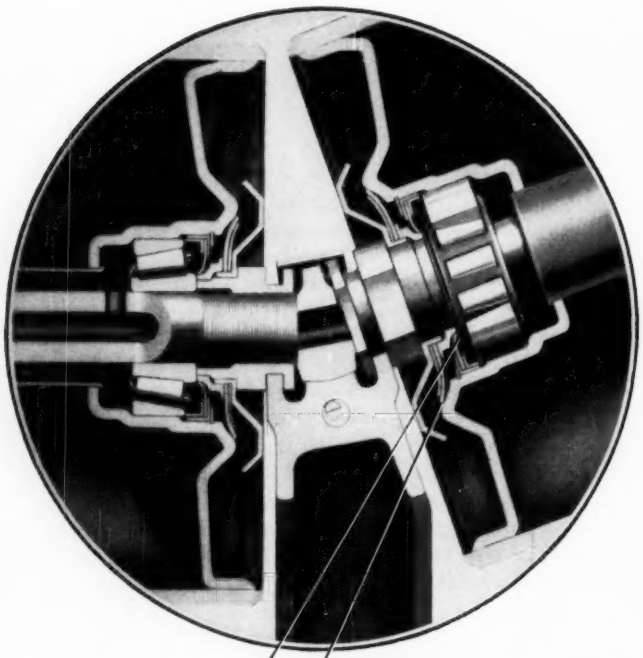


Jeffrey **PERMASEAL** Idler

Diaphragm double seal for extra-severe, extra-satisfying service



Jeffrey Permaseal belt idlers give you extra-long service with an absolute minimum of maintenance. You can see why. The diaphragm double seals protect both ends of every roller. Grease can't get out; dirt can't get in.

And the positive seal means you can add grease to either side of a Jeffrey Permaseal idler without danger that grease might escape from the other side onto the conveyor belt. No grease pipes are needed.

Greater dependability and longer life offset slightly higher initial cost.

Complete facts on the extras you get from Jeffrey are available in Catalog 909. Write The Jeffrey Manufacturing Company, 909 North Fourth Street, Columbus 16, Ohio.

CONVEYING • PROCESSING • MINING EQUIPMENT...
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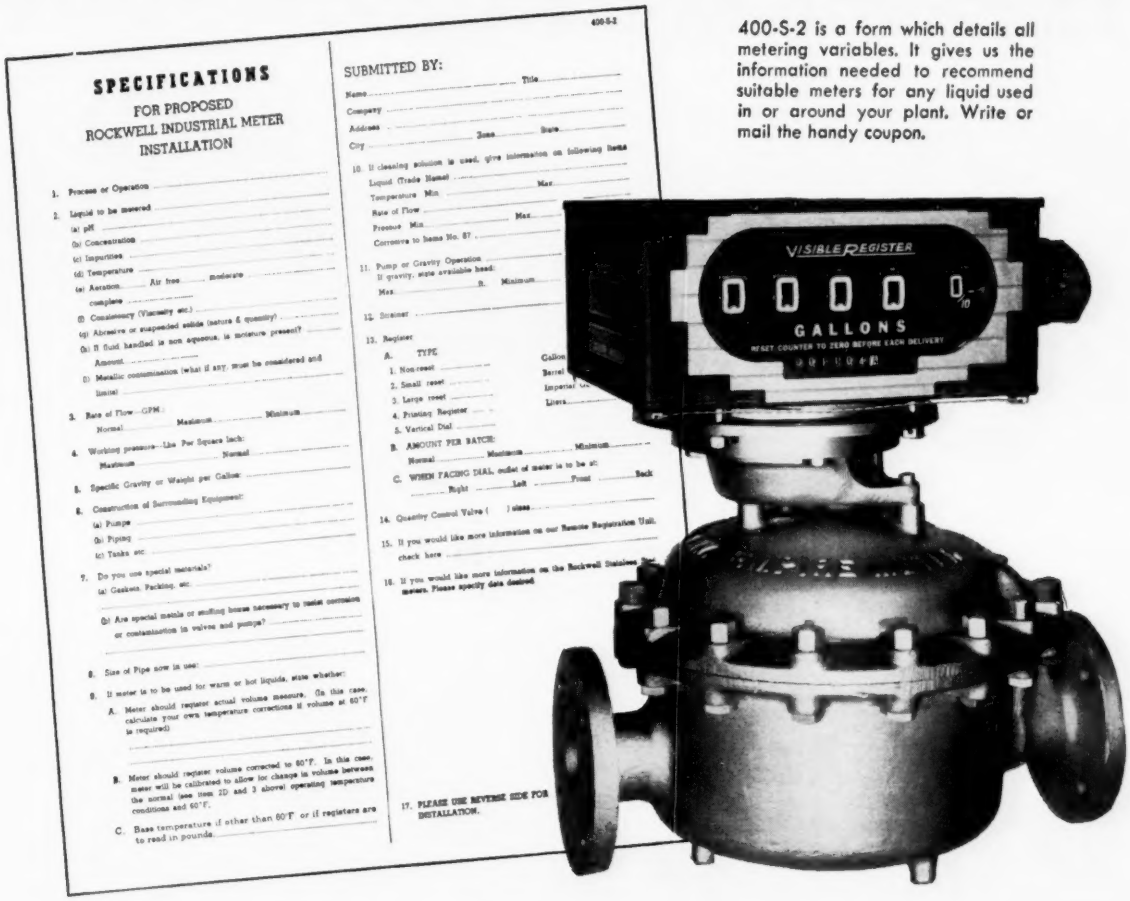
JEFFREY

Did You Ever Hear of 400-S-2?



400-S-2 is a form which details all metering variables. It gives us the information needed to recommend suitable meters for any liquid used in or around your plant. Write or mail the handy coupon.

If it's a liquid . . . that can be poured or piped

ROCKWELL CAN METER IT!

(Corrosive liquids, too!)

We can't tell you how to make your product, but we can meter it! For that matter we can meter most any liquid used in making or processing your product . . . and to your advantage. With Rockwell industrial meters you can batch, blend and control formulas with precision. You can guard costly inventories, control costs. And with Rockwell automatic quantity control valves you can save time and money on repetitive operations. Find out now about the size and type Rockwell meter that will fit your service needs to a tee. Write or use the handy coupon.

INDUSTRIAL METERS

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CLIP COUPON—MAIL TODAY

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I am interested in measuring _____
(Name of Liquid)

Pipe Size _____"

Working Pressure _____psi Temperature _____°F max.

Max. Flow Rate _____gpm Min. Flow Rate _____ gpm

Your Name _____

Company _____

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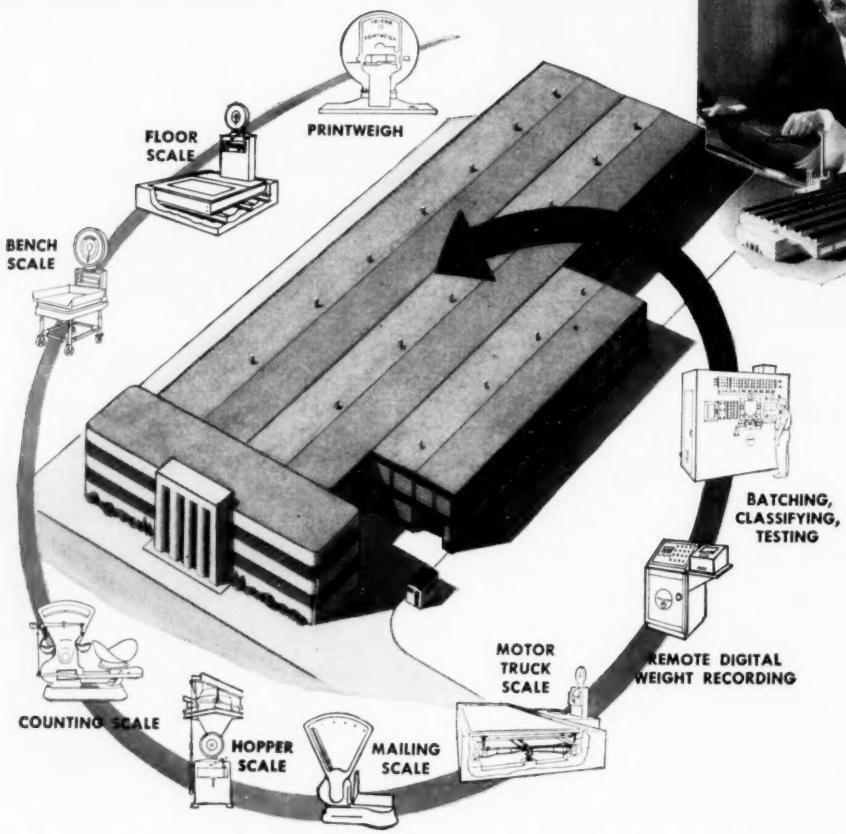
City _____ Zone _____ State _____

Studying Costs? It pays to start with a *Plant-Wide Look* at WEIGHING!



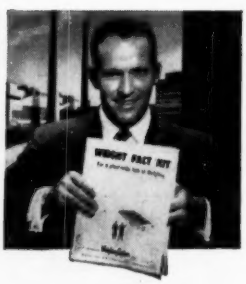
You can lessen the impact of rising costs by making sure your scales are doing the best possible job. Remember that weighing today is not a job for isolated scales—it's a vital element in your overall cost control system.

Weight records affect costs, quality, inventory control and customer billing. Weighing errors, or inadequate weight data, can be avoided by having the right scales in the right places . . . all carefully integrated in a plant-wide weighing system to supply basic records on materials received, shipped or transferred. Check your needs now! TOLEDO SCALE Div. of Toledo Scale Corp., 1403 Telegraph Road, Toledo 13, Ohio.

TOLEDO SCALE

Headquarters for Weighing Systems

DIVISION OF TOLEDO SCALE CORPORATION



☐ **NEW TOLEDO WEIGHT FACT KIT** will help you determine how well your scales measure up as a weighing system—help you detect weighing losses that drain profits. Request your kit now. No obligation.

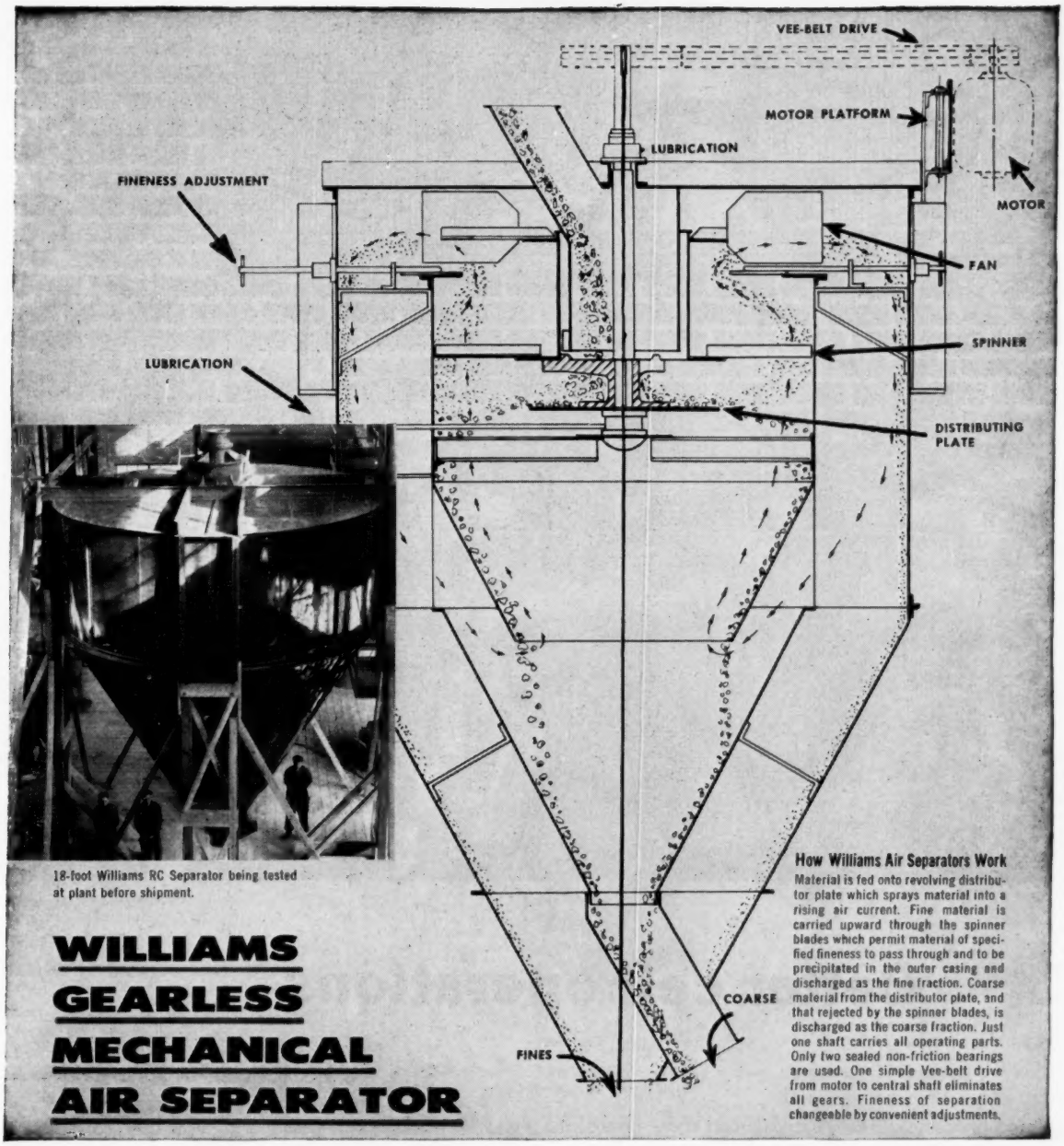
☐ Counting Scales

☐ Electronic Load Cell Scales

☐ Motor Truck Scales

☐ Electronic Remote Digital Weights

☑ WE'LL BE GLAD TO MAIL THE LITERATURE YOU CHECK.



18-foot Williams RC Separator being tested at plant before shipment.

WILLIAMS GEARLESS MECHANICAL AIR SEPARATOR

How Williams Air Separators Work

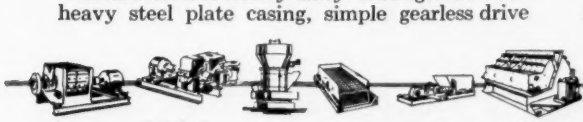
Material is fed onto revolving distributor plate which sprays material into a rising air current. Fine material is carried upward through the spinner blades which permit material of specified fineness to pass through and to be precipitated in the outer casing and discharged as the fine fraction. Coarse material from the distributor plate, and that rejected by the spinner blades, is discharged as the coarse fraction. Just one shaft carries all operating parts. Only two sealed non-friction bearings are used. One simple Vee-belt drive from motor to central shaft eliminates all gears. Fineness of separation changeable by convenient adjustments.

20 To 325 Mesh Separations—Trouble-Free Gearless Operation

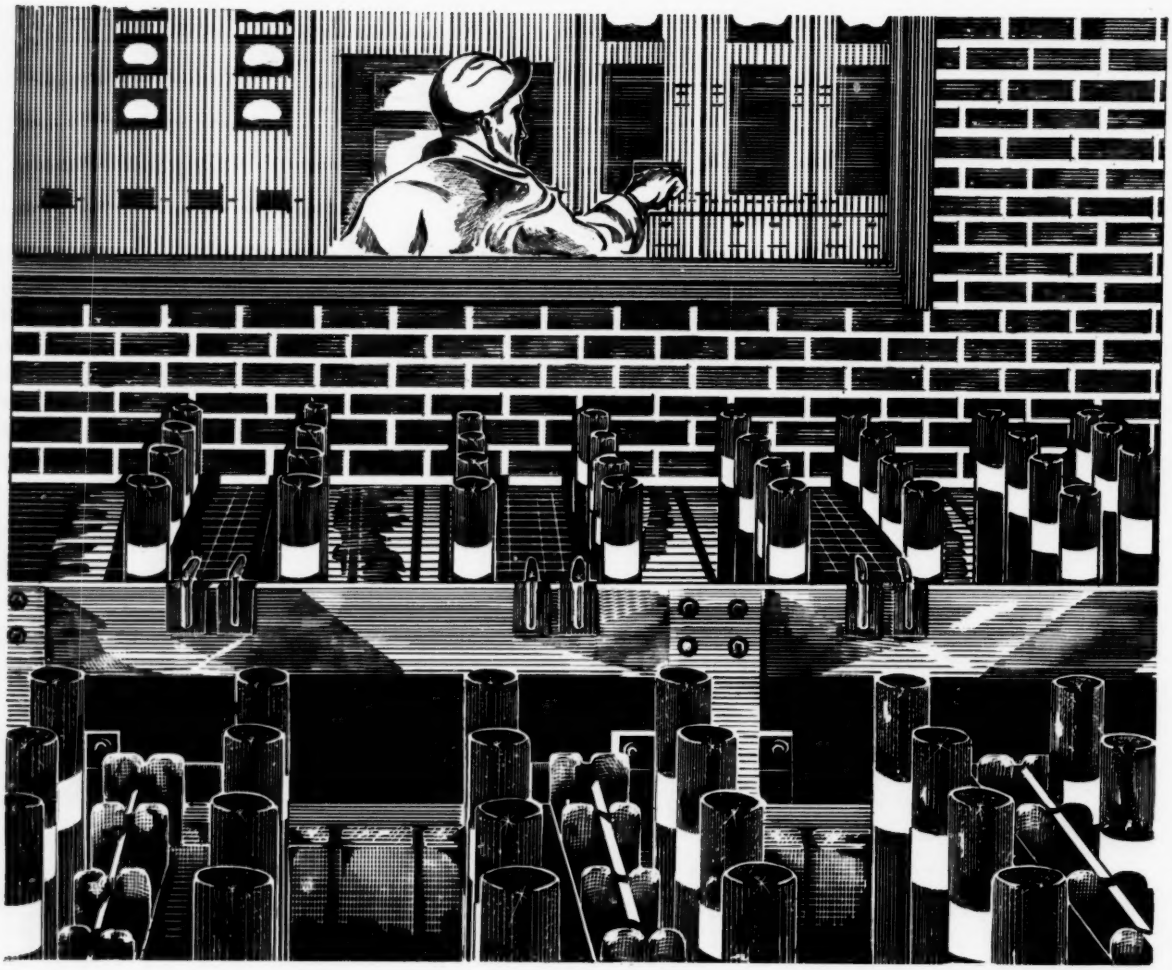
For removing fines from coarsely ground material or for making separations of fine material (the separations ranging from 20 to 325 mesh), Williams Mechanical Air Separators provide the lowest cost, maximum production equipment yet devised. Separation is by specific gravity and no fine delicate screens are employed. Output is unusually high even for fine separations. Construction is heavy duty throughout with heavy steel plate casing, simple gearless drive and heavy internal construction. Only two anti-friction bearings are used. They are enclosed in dust-proof and moisture-proof housings. All sizes permit adjustment for wide variation in fineness of separation. Let us send you complete information.

9 Standard sizes. Capacities, ¼ ton to 75 tons hourly.

WILLIAMS PATENT CRUSHER & PULVERIZER CO.
2706 North 9th Street St. Louis 6, Mo.



WILLIAMS
CRUSHERS GRINDERS SHREDDERS
Oldest and Largest Manufacturers of Hammer Mills in the World



Better cell operations

The technical skills and experienced know-how of the men who operate mercury cells, are most important factors in low cost chlorine-caustic production.

Equally important is the superior performance of GLC anodes, which are "custom made" to individual cell requirements.

FREE—*The cell operation illustrated here has been handsomely reproduced with no advertising text. We will be pleased to send you one of these reproductions with our compliments. Simply write to Dept. N-4.*

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18 EAST 48TH STREET, NEW YORK 17, N.Y. OFFICES IN PRINCIPAL CITIES

RECIRCULATION MAY BE KEY TO FUTURE GROWTH OF CHEMICAL AND INDUSTRIAL PROCESSES

• AN ADAMS REPORT

Number 2 of a Series

How much water do you need to make: a ton of steel? a ton of synthetic rubber? a ton of bromine? a barrel of beer?

These are not empty questions. They point to a critical problem which confronts management today in its plans for tomorrow. It is more crtical than most of us realize . . . for industry today uses as much water as all other users.

Industry's Needs in 1975

Water is vital for chemical and industrial growth. By 1975, industry will require 215 billions of gallons daily. That is a 100% increase over our current industrial consumption . . . more than we currently consume for all uses combined.

Competing for this water will be irrigation farmers and the general public. Their combined needs by 1975 will be up 40 billion gallons a day . . . possibly even more.

What is the Supply Picture

More than 40% of the communities in the United States already have a critical water supply problem. Yet, to meet the 1975 needs, our supply must be expanded by 50%, at an estimated cost of $50 billion.

Indications are that industry is going to have to bear its part of this cost. Certain communities are already moving to place flat water rates on all users . . . regardless of the volume used. Other groups are demanding a national water policy with full Federal Government regulation of natural sources.

Chemical Industry's Stake

Shortage of water can be a most serious threat to the expansion hopes of the chemical industry. A glance at the following table shows why. You need approximately:

20,800 tons of water per ton of	Bromine
2,500 " " " " " "	Synthetic rubber
830 " " " " " "	Viscose rayon
300 " " " " " "	Newsprint
208 " " " " " "	Smokeless powder
15 " " " " " "	Coke from coal

While process refinements may be able to reduce slightly the amount of water needed for each product, the gains will be minor.

Difference Between Use and Consumption

This is best illustrated by the water needed to make a ton of steel. The industrial average is 65,000 gallons (271 tons). In the past, 65,000 gallons of water flowed out of a river through the steel mill and back into the river again for each ton of steel made. In this case, use and consumption are one and the same thing.

On the west coast, a large steel mill now requires only 1,100 gallons of makeup for each ton of steel produced. This steel mill has its own recirculation system which holds several million gallons of water. This water is recirculated at a rate equal to 65,000 gallons per ton of steel produced. The only water consumed is that lost due to evaporation or through leakage. Thus, net consumption has been reduced to 1,100 gallons.

Two Bulletins Available

One of the most important pieces of equipment in a recirculation system is a filter. Where high quality process water is needed, diatomite filters will provide an effluent second only to distilled water. Bulletin 651, released by the R. P. Adams Company, Inc., 207 E. Park Drive, Buffalo 17, N. Y., covers this type of industrial water filter.

A second publication, Bulletin 909, covers an Automatic Water Filter which is frequently used in recirculation systems where the water is used for less critical applications. This bulletin is also available on request from the R. P. Adams Company at the above address.

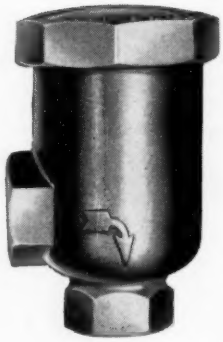
By the way, it takes almost two tons of water to brew a barrel of beer.

need

steam traps?

name the way you want them!

TYPE A



TYPE D

TYPE C

Nicholson can supply your steam traps, exactly as you want them . . . for any service, any condition. Name the size, material, pressure, capacity you need. Types A, D, C are the ones you'll most likely use. Make your selection.

Sizes: A—from ¼" to 1". D—from ¼" to ¾". C—from ½" to 2".

Materials: Cast Iron, Cast Steel and Bronze.

Pressures: A and D—Vacuum to 200 lbs. C—Vacuum to 300 lbs.

Capacities: From two to six times greater orifice area and capacity than other traps of comparable size.

Why wonder about your steam traps . . . when you can get Nicholsons exactly as you need them for your own applications. Nicholson traps are simple in design, have only one moving part . . . a valve that discharges condensate and prevents steam loss.

You get faster warmup, with high air-venting capacity. You eliminate costly leakage, with a powerful shut-tight valve action. You get a trap that's service-tested, when you specify Nicholson. You can try one . . . without obligation! W. H. Nicholson and Company, 12 Oregon St., Wilkes-Barre, Pa. Sales and engineering offices in 98 principal cities.

NICHOLSON

of Wilkes-Barre

Square D Vertical Action Magnetic Starters Sizes 0, 1, 2, 3, 4 and 5

ONLY SQUARE D GIVES YOU ALL 5

1 *QUICK* INSTALLATION!

No groping or fumbling. Square D gives you lots of wiring space, plenty of knockouts, handy and clearly marked pressure wire connectors.

2 *TOP* PERFORMANCE!

No needless downtime from coil burnout, mechanical binding, contact freezing. Square D gives you an extra-capacity magnet with a tough and cool-operating encapsulated coil to handle additional poles and interlocks—a guided single moving part—big silver cadmium-oxide contacts with strong finger springs—arcing yokes on larger sizes.

3 *REAL* OVERLOAD PROTECTION!

No change in trip characteristics because of mismatched parts supplied separately for field assembly, no distortion of heater in installation. Square D gives you melting alloy unit construction—factory-assembled and individually tested for bull's-eye accuracy. Also bi-metal and magnetic designs for automatic reset or adjustable trip applications.

4 *EASY* INSPECTION and MAINTENANCE!

No starter is "maintenance-free." But Square D makes the job easy. Inspection is a breeze. You don't have to remove wiring for contact replacement or take the starter out of the enclosure to change coils.

5 *WIDE-RANGE* ADAPTABILITY!

No need for excessive inventories to avoid costly waiting for non-standard arrangements. Square D provides "off-the-shelf" kits for changing contacts and coils, adding pushbuttons, selector switches, and up to 4 double-throw auxiliary circuits.

Send for the COMPLETE Story!

Square D Company, Dept. 27,
4041 North Richards Street, Milwaukee 12, Wisconsin

Please send me your new bulletin with detailed proof that Square D offers me my best starter investment.

Name_____

Company_____

Address_____

City_____ Zone___ State_____

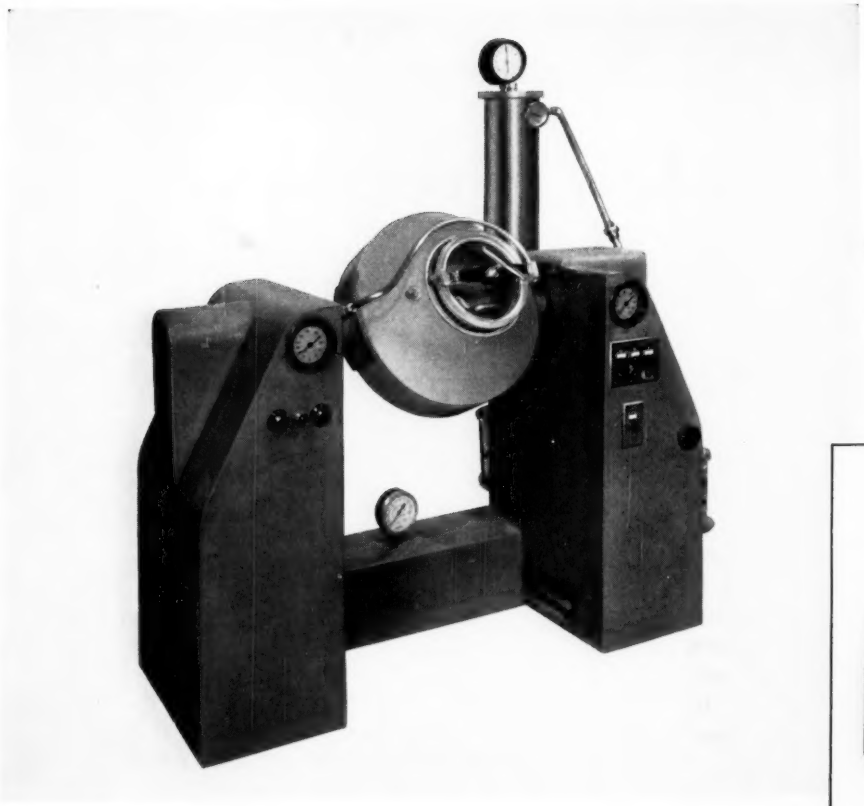
SQUARE D COMPANY

Chemical Engineering

Developments

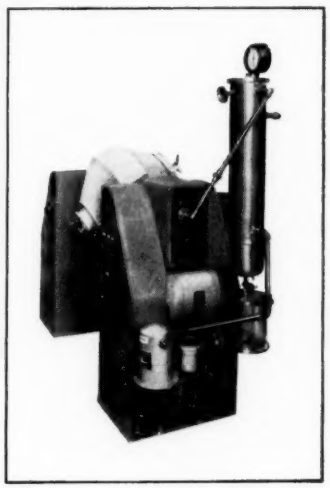
APRIL 7, 1958

Department Index



Completely integrated vacuum drying system using P-K Vacuum Tumbler Dryer Blender.

Side view, showing vacuum pump, condenser and related components. Note compact arrangement and short lengths of piping.



The P-K Vacuum Tumbler Dryer

A faster, better way to vacuum-dry heat sensitive materials

The remarkably fast drying action of the P-K Vacuum Tumbler Dryer—a fraction of the time required by conventional methods—is partly accomplished by baffling in the jacket, which circulates the heating medium uniformly around the containing vessel. In addition, rapid generation of vapors produces a scrubbing action on the walls of the blender, improving the heat transfer rate to a marked degree.

These factors, important as they are, do not tell the whole story. The P-K Dryer operates at optimum efficiency when it is part of a completely integrated, factory engineered system, instead of an on-site assembly of component parts and piping—which increases the cost and impairs the attainable benefits. For heat senstive material drying, in a closed system, there must be a perfect balance of jacket circulation, vapor filter, vapor line, *compact* piping, vacuum line, vacuum pump and effective controls.

These essential relationships P-K provides, including factory designed supports to house the entire operation. The illustrations show a unit used in P-K's Customer Service Laboratory to pre-test the specific requirements of your formulae. You are urged to use this service without cost or obligation. Similar integrated units can be designed for your needs in capacities from 1 to 150 cubic feet.

Use the coupon to secure Data Sheet No. 1530. Better yet, contact our Customer Pre-test Department for a test if your heat sensitive formulations are difficult to produce rapidly, satisfactorily—and economically.

Patterson Kelley

Chemical and Process Division

Executive offices and plant: East Stroudsburg, Pa.

P-K "Twin Shell" Blenders • Heat Exchangers • Packaged Pilot Plants • P-K Lever-Lock Doors • P-K Cone and Ribbon Blenders

Patterson-Kelley Co., Inc.
1504 Hanson Street
East Stroudsburg, Pa.

Send me the information on vacuum drying checked below:

☐ Data Sheet No. 1530
☐ P-K pre-test of our product

*Name*_____ *Title*_____

*Company*_____

*Street Address*_____

*City*_____ *Zone*____ *State*_____

DEVELOPMENTS . . .

APRIL 7, 1958

Chementator

C. H. CHILTON

√ **Low-temperature carbonization of Wyoming coal is aim of newly organized group, Columbia Western Corp. Plans call for investment of $1.75 million in plant to process 1,000 tons/day.**

√ **In addition to Alkar (see item at right), UOP has just announced the Butamer process for converting normal butane to isobutane over a specially prepared Pt catalyst. Isobutane is needed in increasing quantities for production of alkylate gasoline.**

√ **Nepheline, a mineral much lower in alumina content than bauxite, is now being used for commercial aluminum production in Russia. Coproducts of nepheline processing are portland cement, various sodium and potassium chemicals.**

Petrochemical entree for small refiners

An economical way for the small petroleum refiner to upgrade the 8-10% ethylene-propylene content of refinery offgases has just been offered by Universal Oil Products Co.

Rather than separate the olefins from the main gas stream by means of expensive absorption-refrigeration-distillation equipment, UOP proposes to treat the entire gas stream with benzene. This would alkylate the olefins to ethyl benzene and cumene, which are then easily separated from the unreacted gases. Alkylation takes place in fixed-bed reactors over an unidentified, "completely new" solid catalyst.

Eastern States Petroleum & Chemical Corp., Houston, has been studying the new process—which UOP has named the Alkar process—for a number of months but has not yet reached a decision. Main drawback right now, says the company, is that the only big outlet for ethyl benzene is in making styrene, so that a decision to put in the Alkar process actually involves the more basic decision to go into styrene production.

UOP estimates that as much as 1.5 billion lb./yr. of ethylene is now being burned as refinery fuel in the U. S.

Urea process eliminates drying step

A big problem in making urea—control of biuret content of the prilled product—may be solved by recent improvements in the Montecatini process.

The process changes are already in effect in a new 200-ton/day plant in Japan (Ube Industries Ltd.), which started up last October, and will be incorporated in the 100-ton/day plant Spencer Chemical is now building at Henderson, Ky.

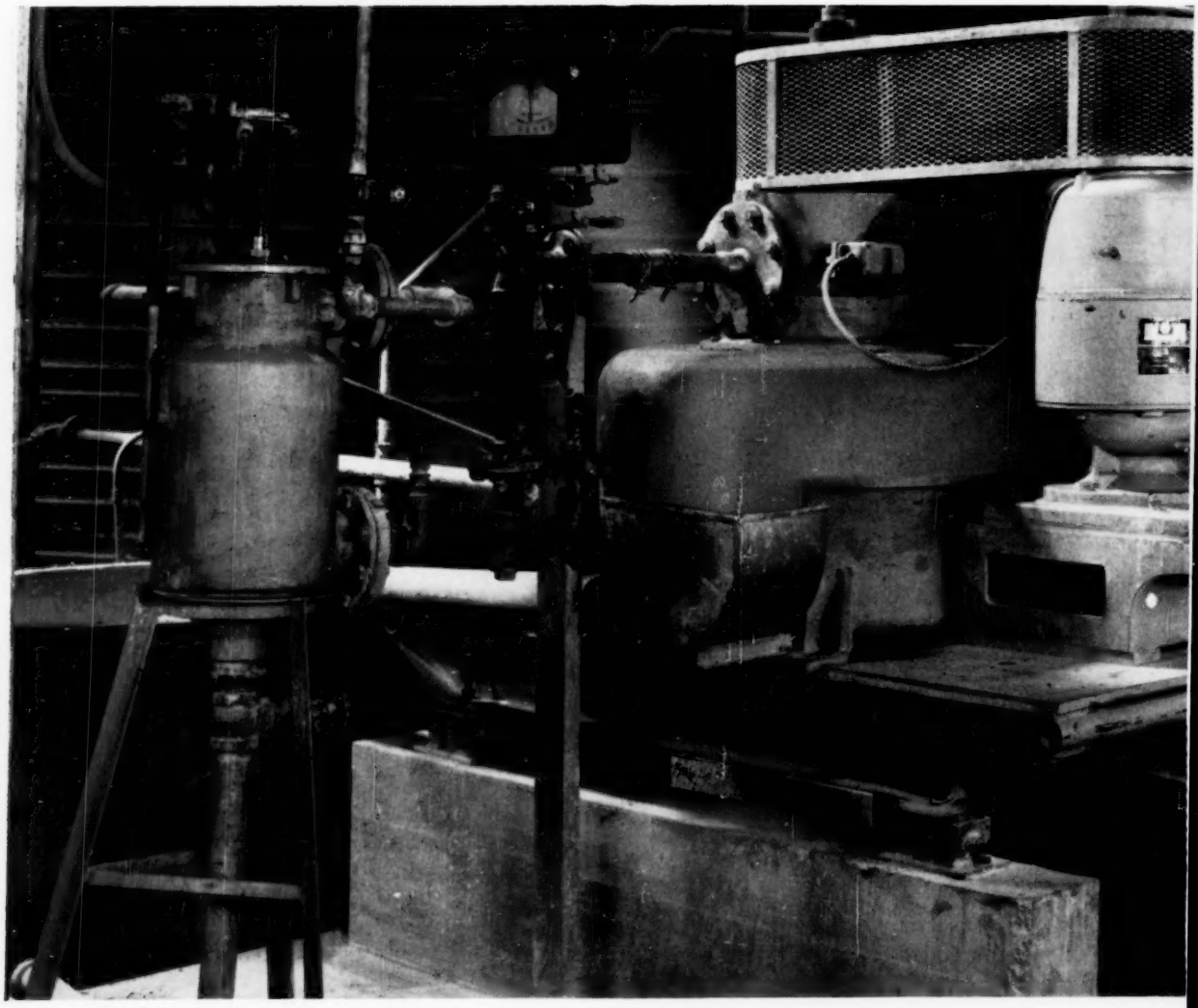
Montecatini claims that its process can now evaporate urea solutions to such a low water content (less than 0.8%) before prilling

(Continued on page 56)

Merco Centrifugal Classification of Micron Size Particles

In the production of extra fine grade bentonite clay . . . a large mid-western chemical company makes skillful use of the effectiveness of Merco Centrifugal Separators in classifying micron size particles.

In this beneficiation process, the clay, after a primary rough cut, is fed to a Merco A-24 Centrifugal Separator for secondary classification.



Final cut is made in a high speed Merco Model C-30 Centrifuge which produces the consistently high quality end product.

The Merco Centrifuge, incorporating the unique return flow principle, can continuously handle the 5 basic separations . . . concentration, clarification, washing, soluble recovery and classification . . . on a 24 hour a day, 7 day a week basis.

For more details on the complete line of Merco Strainers, Centrifuges and Screening Centrifuges, just drop a line to Dorr-Oliver Incorporated, Stamford, Connecticut.

Merco — T.M. Reg. U. S. Pat. Off.

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INCORPORATED
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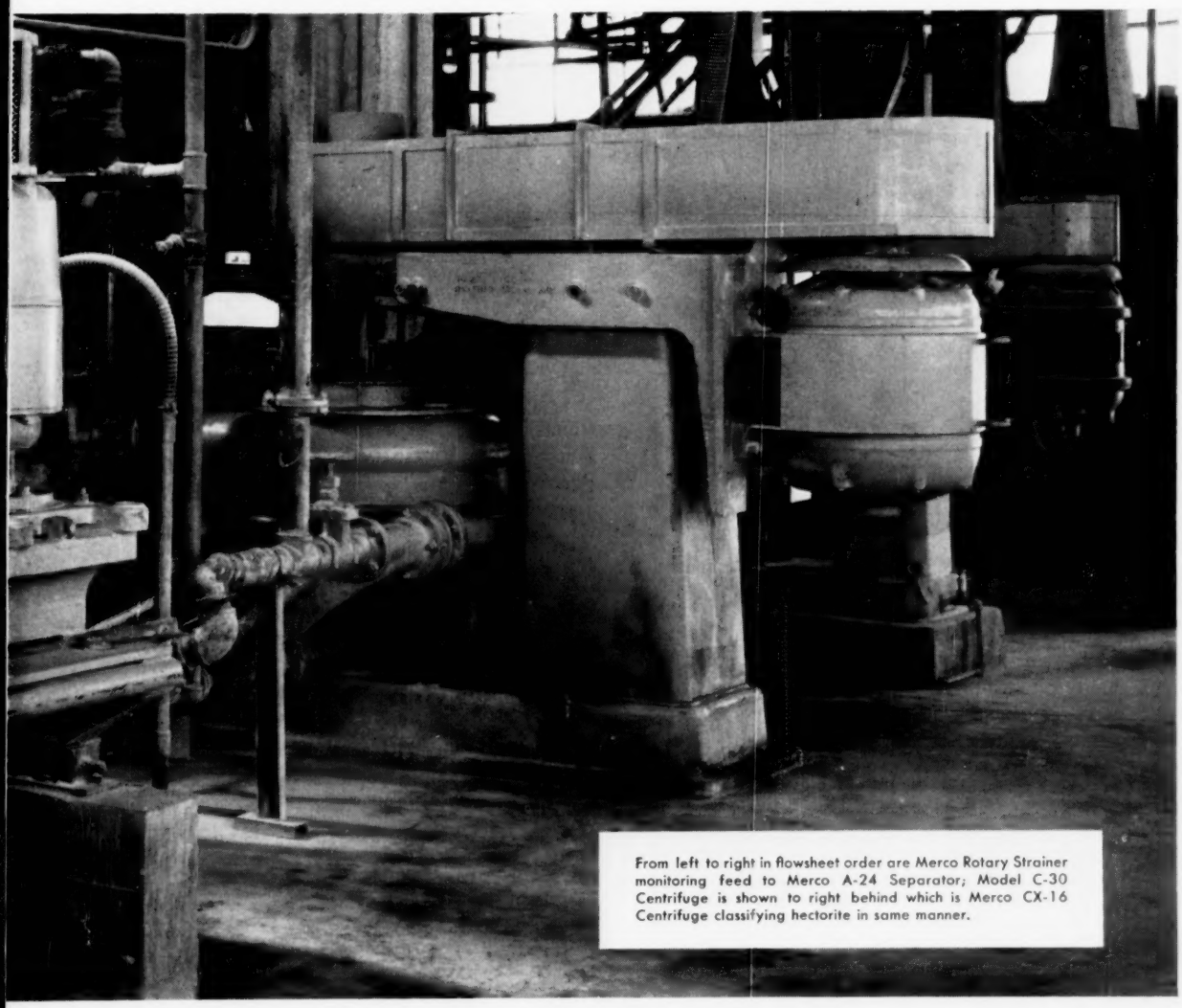


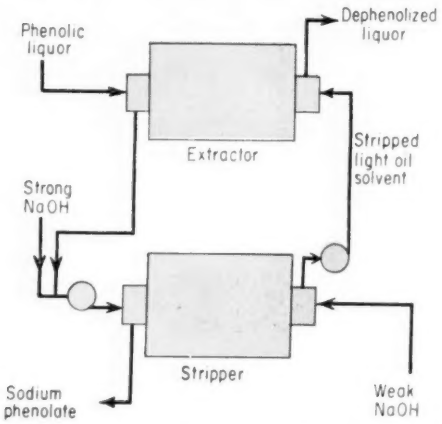
From left to right in flowsheet order are Merco Rotary Strainer monitoring feed to Merco A-24 Separator; Model C-30 Centrifuge is shown to right behind which is Merco CX-16 Centrifuge classifying hectorite in same manner.

so that subsequent drying of prills is unnecessary—and do it while keeping critical biuret content below 1%.

Secret is to use lower-than-usual operating pressure and temperature and low residence time in the concentrator. Temperature is 135 C. and pressure is less than 0.1 atm. Control of this step is rather touchy, however, inasmuch as too low a temperature can cause premature crystallization of the molten urea.

Prilled urea may reach a 2-4% biuret content and can't be used for certain applications, such as pineapple crops. Biuret can be practically eliminated, of course, when making crystal urea, but this procedure is more expensive than prilling. Besides, crystal urea is not suitable for direct application to the soil in solid form. With Montecatini's new technique, urea producers may be able to have their cake and eat it too.

Two-stage stripping nets high yields



Successfully achieving what at first appeared to be two mutually exclusive objectives, Allied's Wilputte Coke Oven Div. will soon move its process for removing phenol from coke-oven liquor into its second big commercial application. A 250,000-gal./day unit now being engineered for Semet-Solvay's Buffalo plant will incorporate—and extrapolate—valuable operating experience gained this past year in Weirton Steel Co.'s 200,000-gal./day installation.

Wilputte's process dephenolizes ammoniacal liquor by extraction with aromatic light oil in a Podbielniak centrifugal contactor, then recovers the phenol as saleable sodium phenolate by stripping the solvent with caustic soda solution in another centrifugal machine. Caustic concentration greatly influences process efficiency; with dilute caustic, phenol removal is high, but the phenolate produced is much too dilute.

Solution to this dilemma lies in two-stage stripping. Strong caustic solution (29% NaOH) is added at the suction of the pump which feeds phenol-rich solvent to the stripping contactor. Although quickly rejected by the contactor, the strong caustic has already done most of the stripping job. The rest of the phenol is picked up by a weak (10%) caustic stream fed to the other end of the contactor and traveling countercurrent to the solvent flow. The combined aqueous streams contain about 35% sodium phenolate (a satisfactory concentration) and represent about 99% recovery of phenol.

Wilputte engineers are setting their sights a bit higher on the Semet-Solvay job. Instead of 29% and 10% NaOH, they plan to try something like 35% and 5%. In this way, they hope to boost phenol recovery to 99.5% and sodium phenolate concentration to as high as 40%.

New way to react liquids with solids

Use of a rotary filter as a liquid-solid reactor or contacting device, rather than as a separation tool, may grow out of work now going on in Louisiana State University's chemical engineering laboratory.

In a research project sponsored by National Council for Stream Improvement, Herbert Berger, the council's Southern resident engineer, is setting up a 1-ft.-dia. by 1-ft.-face precoat filter which will pass kraft pulp bleachery waste through a cake of hydrated lime. Earlier work with stationary porous glass filters showed that organic color bodies in the waste react at the surface of the cake, forming a thin, relatively dry layer which can be readily doctored from the surface, renewing it for further reaction. On a commercial scale, the lime-organic product would go to the kraft mill's lime kiln, where the organics would be burned off and the lime used in the pulping process.

Although color is not a critical problem in kraft mill wastes today, says Berger, it could easily become more important in the near future. Accordingly, the kraft industry is showing considerable interest in the LSU

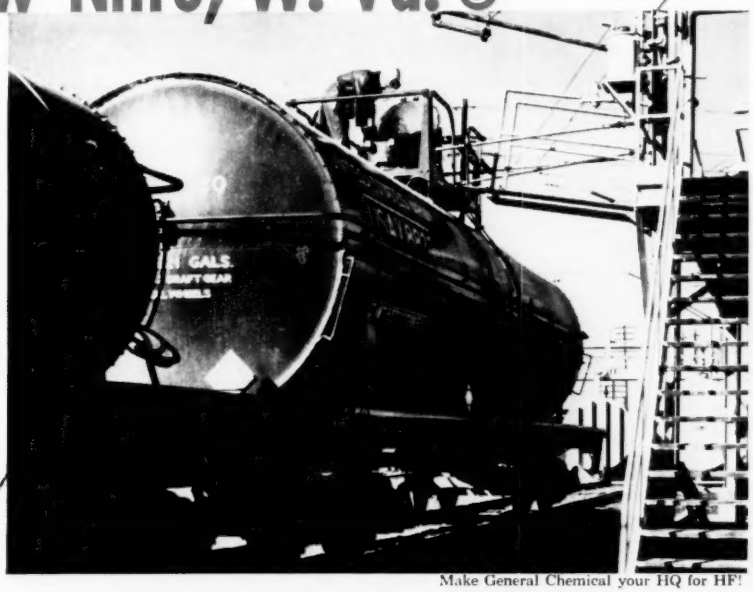
(Continued on page 58)

General Chemical announces its

THIRD HF PLANT!

Now Nitro, W. Va. ③

① MARCUS HOOK, PA.



Make General Chemical your HQ for HF!

② BATON ROUGE, LA.

Construction is now underway for General Chemical's third hydrofluoric acid plant. Producing both aqueous and anhydrous acid, it will augment the company's already extensive HF capacity at Baton Rouge, La., and Marcus Hook, Pa.—and assure ample reserves to meet industry's needs for the foreseeable future.

Your Most Dependable Source of Supply for HF

General Chemical is the *only* supplier offering shipment from more than one producing location. In addition, it has five HF stock points at Buffalo, N. Y., Chicago, Ill., Cleveland, O., El Segundo, Calif. (Los Angeles), and Pittsburgh, Pa.

Also important to you is General Chemical's integrated raw materials position—your best protection against interruptions of supply. General owns and operates its own fluorspar mines and mills, and sulfuric acid plants. These, together with multiple, high-capacity HF plants, plus strict quality control all along the line, make *General* your most dependable source of supply for hydrofluoric acid.

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work. Meanwhile, Berger expects to determine in his upcoming experimental program optimum values for such variables as cake thickness, particle size, depth of cut per pass.

Fast action thwarts Ni-Co equilibrium

For several years Sherritt Gordon Mines, Fort Saskatchewan, Alta., has been winning cobalt and nickel via hydrogen reduction (*Chem. Eng.*, June 1952, p. 164). Now it has added a new process twist that neatly sidesteps chemical equilibrium limitations and gives cobalt of higher purity than previously possible.

In final cobalt-producing steps, nickel is removed from a 50-50 solution of cobalt and nickel diamine sulfates by preferential hydrogen reduction in presence of ammonia at 350 F. and 500 psi. Under these conditions, however, the solution in equilibrium with the solid Ni phase has a Co:Ni ratio of 100, yielding upon further reduction a cobalt metal with an impurity of at least 1% Ni.

To get around this purity limit, SG now seeds the mixed sulfate solution with a specially prepared nickel powder. With controlled ammonia addition, most of the nickel in solution is reduced first and deposits on the nickel seeds. Further ammonia addition then reduces some of the cobalt, depositing on the seed particles a surface coating that is predominantly cobalt. To restore equilibrium with this new "cobalt phase," more nickel plates out and Co:Ni ratio in solution quickly rises to as high as 1,000.

Of course, the solution would soon return to stable equilibrium with the metal phase, but SG draws off the cobalt-rich liquor as fast as possible when optimum reaction point is reached. Cobalt produced by this technique contains only 0.4% Ni and meets normal specifications.

Sulfur from sour gas hits fast pace

With the world's largest sulfur-from-H_2S plant (600,000 tons/yr.) now in the making in France, Mexico's second place in world sulfur production is threatened. Until last year an importer of as much as 300,000 tons/yr., France will soon turn out enough sulfur to feed an export trade as well as meet its own internal needs. Within the next five years, annual capacity may exceed 1,600,000 tons.

The new plant at Lacq, France, draws on recently discovered great reservoirs of sour (15-17%) natural gas. First of three stages of development is now on stream with an output of 225 long tons/day. Three more units of the same size, now being built, will be in business by July, while still a third stage, consisting of two 500-ton/day units, is being planned for completion by next April. Each of these 500-ton units will be larger than any existing U. S. sulfur recovery plant.

The Lacq plant is designed and built by Ralph M. Parsons Co., Los Angeles, and Heurtey et Cie., Paris, for Societe Nationale des Petroles d'Aquitaine.

Sulfur producers are also watching progress in western Canada on another Parsons project — a 235,000-ton/yr. recovery plant being built for British American Oil Co. First of three stages, completed in January 1957, produces 225 tons/day; a second step to be completed by September consists of two more 225-ton/day units, and a final stage will add another 225 tons/day.

Not to be sneezed at is the growing importance of U. S. sulfur production from H_2S. Current production from this source is at the 500,000-ton/yr. level (about 7.5% of total U. S. sulfur production) and is expected to double by 1962.

Soft balls outgrind hard ones

Hard ball or soft ball? In ball mill grinding operations, it can make a difference.

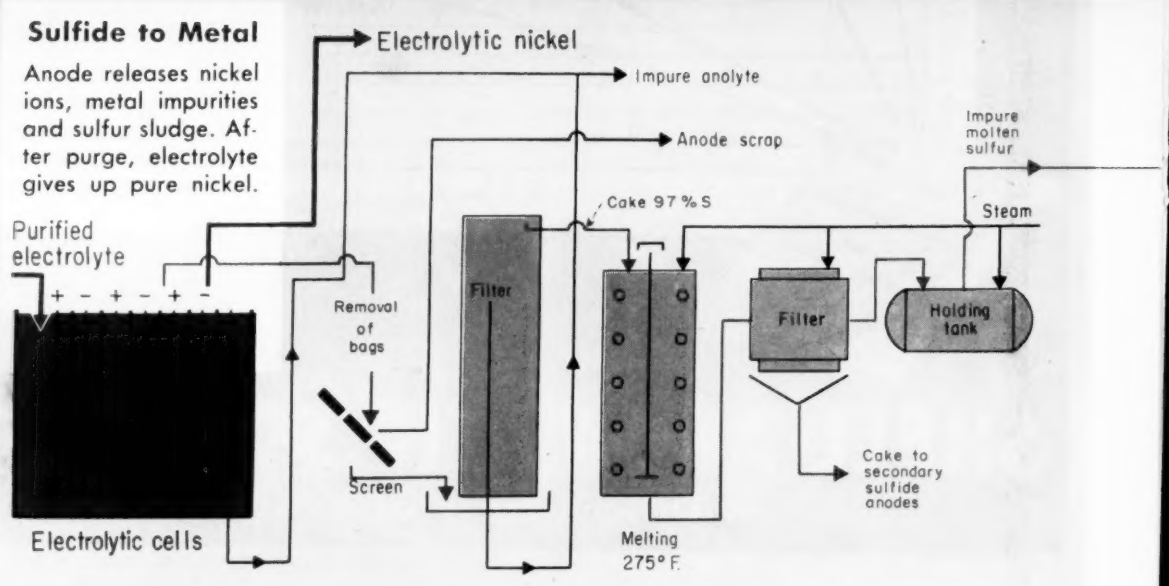
American Metal Climax has found in repeated long-term tests with full-scale equipment that soft balls do more grinding per unit of time and per unit of power consumed than do hard balls. In tests comparing 3-in. balls of forged carbon steel (BHN = 386) with balls of forged hard alloy steel (BHN = 575), the softer balls consistently showed an advantage of about 6% in tons/hr. output.

The difference in grinding rates may be accounted for by the natures of the ball surfaces, postulate Climax enginers. Soft balls develop a rougher surface after a bit of wear, probably giving a greater nipping effect than the smoother hard balls.

The greater wear rate of soft balls, however, can be a liability. Steel consumption per ton of material ground was 24% greater for the soft balls.

For more on DEVELOPMENTS.....60

Electrolysis Wins Bigger Job in



Sulfide Anode Cancels Sinter and Smelt

Without need for metal anodes, nickel refining process eliminates two, expensive, time-consuming, high-temperature steps.

International Nickel Co. of Canada really hit the jackpot at its Port Colborne, Ont., plant when it brought on stream a new process that electrolyzes nickel sulfide directly to 99.9% nickel.

▶ **Nickel Shortcut**—As disclosed recently by L. S. Renzoni, R. C. McQuire and M. V. Barker in a paper given at the annual meeting of the American Institute of Mining, Metallurgical and Petroleum Engineers in New York, Inco's process eliminates need for producing metallic nickel electrodes as a prerequisite to final electrorefining of pure nickel.

By electrorefining nickel sulfide anodes directly to pure nickel, Inco bypasses high-temperature sintering and smelting of nickel sulfide formerly required to produce metallic electrodes. And sludge from electrolysis of sulfide anodes yields income-producing elemental sulfur (see opposite page), selenium and cobalt.

Operation of the refinery's 1,600 electrolytic cells remains essentially unchanged, save for the substitution of sulfide anodes for metallic ones. Purity of the refined nickel is the same high 99.9%.

▶ **Corrode Smoothly** — During electrolysis, the sulfide anodes corrode even more smoothly than their metallic counterparts, according to the reaction:

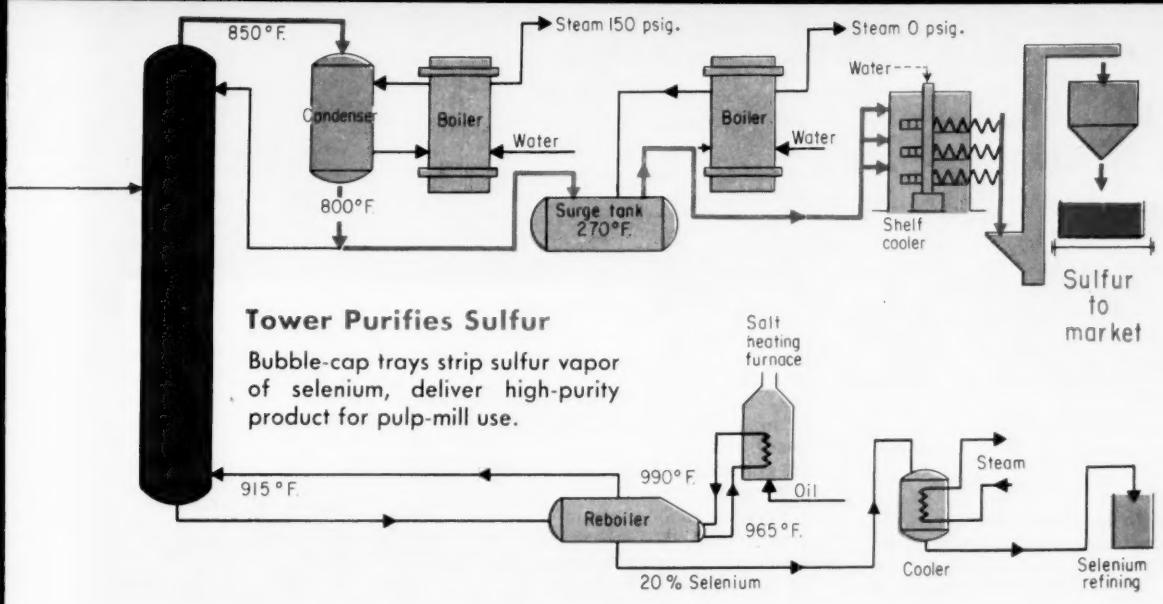
$$Ni_3S_2 \longrightarrow 3Ni^{++} + 2S + 6e$$

As the anode corrodes, sludge builds up within the dynel anode bag to twice the original volume of the anode. During this period, cell voltage rises from 2.3 v. on the first day to about 4 v. near the end of anode life.

▶ **Profit From Sludge**—The voluminous anode sludge adheres to the uncorroded remnant of the anode as a 4-in. cake. Separation of sludge from anode scrap is semi-automatic: Bags are re-

(*Continued on p. 62*)

New Nickel Refining Process



Nickel Process Pioneers Sulfur Distillation

For the first time, a fractionating tower wins a job purifying elemental sulfur. Residual impurity is less than 5 ppm.

As an offshoot of its new nickel electrorefining process (see story opposite), International Nickel operates a unique sulfur purification distillation. Not only does this purification step embody some novel engineering, but it also makes a real contribution to sulfur technology. Up to now, sulfur men have considered distillation a dubious route to pure sulfur.

▶ **Roasting Is Out** — Most Canadian sulfur (used primarily in sulfite pulping) comes from Canada's metallic sulfide ores. It separates from impurities as pure SO_2 during roasting associated with regular metal-recovery operations.

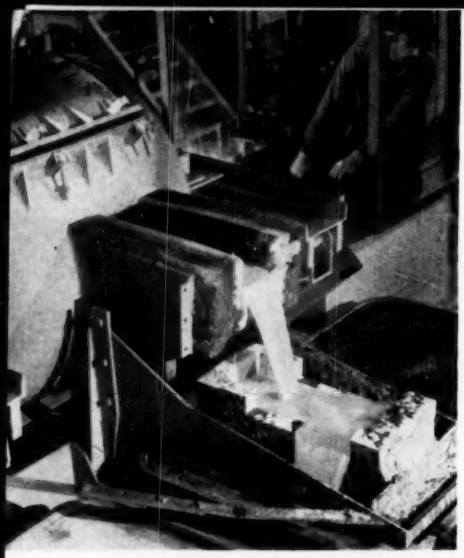
But Inco couldn't economically use the roasting technique to rid its elemental sulfur of 0.15% selenium content in order to meet pulpers' purity requirements. Shipment of SO_2 gas costs considerably more than to ship an equivalent amount of elemental sulfur. So, Inco had to find a way to produce pure elemental sulfur.

▶ **Distillation Wins** — Because the boiling points of sulfur (830 F.) and selenium (1,270 F.) are so far apart, distillation seemed a good way to get pure sulfur. With help from Blaw-Knox, Inco hurdled the many engineering roadblocks between conception and commercial reduction to practice.

Inco's 5-ft.-dia. distillation column stands 98 ft. high, holds 60 bubble-cap trays. Fabricated from Type 309 stainless steel, it operates with a 2.5 reflux ratio.

Impure molten sulfur at 275 F. feeds into the column at an 8,000 lb./hr. rate. Sulfur vapor leaving the top contains only 5 ppm. selenium and is low in ash, bitumens and acid.

Selenium at 20% concentration is tapped periodically from the reboiler and sent to Copper Cliff, Ont., for recovery of pure selenium.



MOLTEN nickel sulfide pours from mobile ladle into anode molds.

Sulfide Anode

(*Continued from p. 60*)

moved and cleaned, anode scrap crushed, and sludge separated from scrap by wet screening.

Anode slime slurry is filtered and washed, removing anolyte. At this point the analysis runs: Elemental S, 97%; sulfide S, 0.7%; Fe, 0.6%; Cu, 0.3%; Se, 0.15%; Ni, 1.25%. Melting and filtering gives a filtrate which is processed for sulfur and selenium (see accompanying story).

Filter cake, containing 50% sulfur and the metal values, is presently being treated by process formerly used for metal-anode residue. Pilot plant studies are now underway for remelting the cake and casting into secondary sulfide anodes for metal recovery.

▶ **Making the Anodes** — Although performance of the sulfide anodes is equal to metallic anodes, casting the sulfide anodes isn't quite as easy.

In laboratory tests, when casting small sulfide anodes, experimenters noticed a faint crackling sound as anodes cooled. These anodes were tough enough to withstand rough handling, however.

But when full-size anodes (28.5 x 43.5 x 1.75 in.) are cast, they fall apart upon air-cooling. Several tests were made with various reinforcements, but without any great success. Other studies showed, however, that slow controlled cooling eliminated cracking.

▶ **Cool It Slowly**—In production operation, anode casting is almost continuous. Sulfide from Inco's standard matte separation process is melted continuously in 200,000-lb./day oil-fired furnace.

Batches of about 7,000 lb. of molten sulfide at 1,800 F. pour into a self-propelled ladle car. About 475 lb. of sulfide are ladled into each of 14 molds. Anodes are allowed to air-cool until they reach 1,000 F.; at this temperature they are quite tough.

Then, anodes are lifted from molds and deposited in a controlled cooling box. After 24 hr. in the box, they are ready for use. Under these conditions of manufacture, anode breakage amounts to only 1%.

▶ **Pleasant Surprise** — Prior to adoption of sulfide anodes, the refinery had used a mixed chloride-sulfate electrolyte. Inco researchers were quite pleasantly gratified when they found that the same electrolyte also gave optimum results with the sulfide anodes. Composition runs about 40 gpl. chloride ion and 78 gpl. sulfate ion.

Because anode contains copper, iron and cobalt impurities that would plate out with the nickel at the cathode, electrolyte must be purified continuously. Impure anolyte is isolated from pure catholyte by a porous membrane.

▶ **Key to Pure Nickel**—Rigorous electrolyte purification always has been the secret for obtaining high-purity nickel plate.

Anolyte, at pH 1.9 and containing 0.3 gpl. Cu, 0.1 gpl. Fe, and 0.1 gpl. Co flows continuously from the cells to the purification loop at 300,000 gal./hr. rate. Addition of nickel hydroxide to raise pH to 4.0 is followed by oxidation and hydrolysis of the iron. Filtration removes the ferric hydroxide.

Chlorine and nickel carbonate, added to the filtrate, precipitate a cobaltic hydroxide slime containing arsenic and lead impurities. Slime is dewatered on filter and sent to cobalt recovery.

Finally, soluble copper in the filtrate is removed by cementation on gas-reduced nickel powder which is filtered out. Nickel-rich electrolyte recycles to cathode compartments.

After part of the nickel plates out, catholyte passes through the diaphragm for replenishment with nickel and soluble impurities from anodes.

▶ **Minor Adjustments** — Electrical potential at the sulfide anodes is 1.2 v., 1 v. more than metallic anodes' 0.2 v. And discharge of hydroxyl ions at the sulfide anodes drops electrical corrosion efficiency from 99.5% to 95%. Resistivity of sulfide anodes equals that of the metal anodes, however.

Higher cell voltage raises electrolyte temperature to 145 F. at anolyte outlet. At this temperature, the strongly acid electrolyte wreaks havoc on the 1.5-in. asphalt cell lining formerly used. A synthetic resin has been found to withstand the more severe conditions.

Cotton diaphragms previously used in the cells succumbed, too. Specially treated dynel-terylene diaphragms solved that one. Bags for the anode sludge also are made of dynel and are coated with neoprene to extend useable life.

Tough Metals Easily Milled With Chemicals

Chemical milling, a trick once exclusively in the domain of the aircraft builders, is now being turned to shaping hard-to-machine newer metals and alloys (e.g., titanium, nickel-cobalt alloys, stainless steels) in U. S. Chemical Milling Co.'s Manhattan Beach, Calif., plant.

Process is based on corrosive action of acid etching bath on metals; stainless steel can be "milled" as rapidly as the much softer aluminum. Metal part to be milled is cleaned and masked, leaving portion to be milled exposed. The part is immersed in etching bath for carefully controlled time; etching rate is around 1 mil/min. Complex shapes are milled in several successive etching steps.

Chemical milling boasts these advantages: Removes material inexpensively from metals too tough to machine; handles many parts at once with semi-skilled labor; removes metal from areas where machine tools can't reach; handles large pieces without special machinery. Tolerances run from 0.000 in. on light cuts to 0.002 on heavy cuts.

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Capacity lb/hr	Operating Pressure psig	Final Steam Temperature Deg. F	Feedwater Temperature Deg. F	Fuel	Efficiency	Steam Quality
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60,000	285	Sat.	220	Nat. Gas	78.3	3 ppm Solids Carryover
63,700	150	Sat.	225	No. 6 Oil	83.7	0.5% Moisture Carryover
68,000	620	Sat.	350	No. 6 Oil	80.9	1 ppm Solids Carryover

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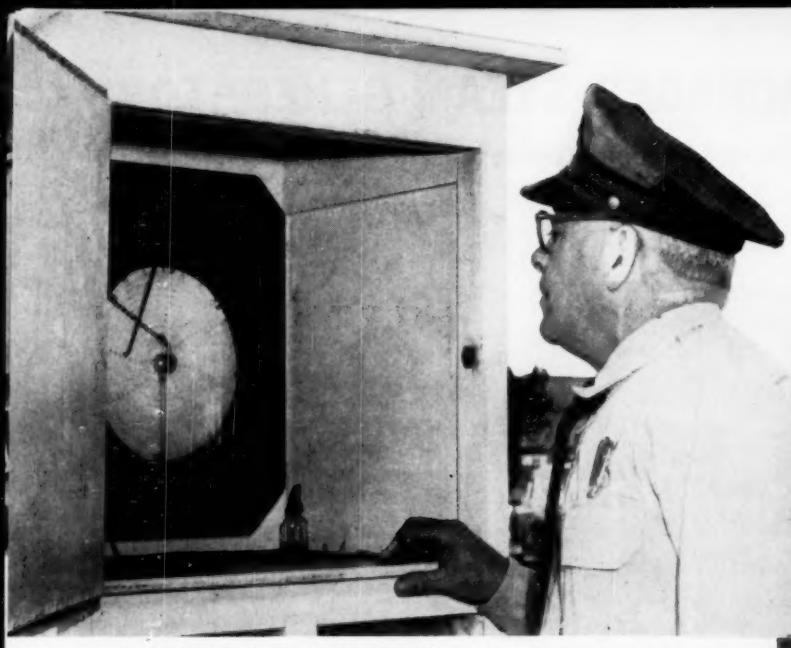
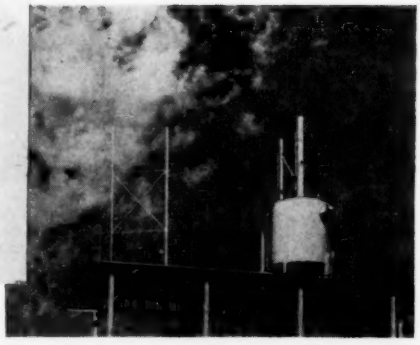




PLANT STAFFER checks ambient temperature recorder, part of weather gear that helped designers locate tank vents (right).

Weather Eye Guides Plant Layout and Design

Dow's private weather bureau logs data that wins a leading role when engineers lay out and design a new plant.

Mark Twain really started something when he made the remark that everyone talks about the weather but no one does anything about it. People have been quoting him ad nauseam ever since.

Dow Chemical Co. certainly isn't trying to refute Mr. Twain, but it is indeed doing something about the weather. Dow's plant at Pittsburgh, Calif., has been keeping a detailed record of local weather conditions for the past several years.

Its weather data now plays a part in equipment design and plant layout, has added a new dimension to personnel safety. And the program also pays off in that all-important profit column.

Many companies (especially those on the Gulf Coast) have emergency shutdown programs requiring that they keep close tabs on approaching storms. But Dow goes further than that: Its own on-site instruments give the complete weather picture—not just storm conditions. Temperature, rainfall, wind velocity and direction, and dew point are all logged in Dow's private weather journal.

▶**Takes Own Temperature**—Dow's program is relatively inexpensive compared to the benefits it has yielded. Installed cost of the instruments was only $3,000 and only five man-hours per week are required to take and record readings.

Biggest expenditure was for a $2,000 Bendix-Friez Aero Vane that measures wind direction and speed. Also employed are a U. S. Weather Bureau type rain gage, a temperature recorder and a Foxboro Dewcel dew-point recorder.

Data are stored on IBM cards to keep them readily available in highly condensed form. The weather program is a regular part of the duties of plant maintenance and tabulating departments.

Dow reaps public relations benefits as well as dollars-and-cents profits from the program. Information is regularly made available to local newspapers and radio stations as well as to Dow's other Western-Div. departments. Stanford Research Institute also used Dow's data in an air-pollution study made for a public health agency.

▶**Safety First**—Though in full force only four years, Dow's program already has paid dividends in engineering design and plant safety.

Before erecting its new latex plant, Dow had to find a suitable location on the Pittsburgh property. A down-wind location was called for because a highly flammable material—butadiene—was to be stored in the area. But the ideal down-wind spot wasn't available for construction at the time. With its backlog of prevailing wind data, however, Dow came up with an alternate plant site that is sound—and safe.

In designing the latex plant building, wind data again proved its value. Because of fire hazard from escaping flammable vapors, safety valves on all process equipment had to be equipped with vent stacks. Engineers, armed with wind data, were able to calculate proper stack height to release flammable vapors far from any possible spark source.

▶**Save Money, Too**—Temperature data have taken much of the guesswork out of some design calculations.

In designing the latex plant,

for instance, storage tanks had to be insulated and heated against the sometimes below-freezing Pittsburgh winters. By using the log of daily temperatures, engineers selected an economical insulation thickness and proper-sized heating units. If exact temperature data hadn't been available, the resulting over-design for safety would have added considerable extra cost.

And in designing process vessels, storage tanks and heat exchangers for such things as liquid butadiene, chlorine and ammonia, wall thickness is frequently determined by pressure created at highest ambient temperature. With complete temperature records available, minimum wall thickness (with safety factor) can be accurately picked, over-design avoided.

Dew point data has come in handy, too. For a process material balance, engineers wanted an accurate average nitrogen content in air entering an ammonia synthesis unit. Dew point and air flow data gave this figure, improving process control and efficiency.

▶ **Looking Ahead** — Right now, the plant has plenty of cheap water. But in the future, water supply may become more saline and require treating. Too, manufacturing units locating farther from water supply will mean higher piping and pumping costs. These factors make a once-through water system (that Dow now uses) more costly.

Consequently, company is considering installing cooling towers and reusing its water. But to accurately pinpoint tower size and location, these weather factors are important: Wind velocity, wind direction, and water vapor content in air. Dow's weather journal will provide this information if needed.

Because California summers are so hot, air-conditioned offices are standard at Pittsburgh. Dow's temperature and dew-point data will also assure more accurately designed air-conditioning units in the future.

▶ **Added Fillips** — Besides improving equipment design and plant layout, Dow lists two further bonuses from its weather station:

Weather program is integrated with plant's "crash alarm" system. If toxic or flammable material is accidentally released anywhere in plant, instantaneous knowledge of wind conditions makes it possible to warn all personnel in danger.

And with air pollution becoming an ever-increasing problem, good data on air circulation—both vertical and horizontal—will be needed to arrive at an intelligent solution. Dow now has the data available for its own needs or for those of responsible public agencies.

▶ **It's Catching On** — Dow's Texas Div. also has a data-gathering program similar to the one in operation at the Pittsburgh plant. Instruments, located at plants 100 mi. apart, record key wind and rainfall data. This division, too, has found that weather records pay off in more precise engineering design and employee safety.

And many companies, vitally concerned with the weather's perversities, keep in close contact with the nearest U. S. Weather Bureau station. When alerted on severe storms and hurricanes, companies activate emergency shutdown procedures and ready emergency crews. So far, however, most of these companies confine their interest in weather to storm warnings.

But no matter what tomorrow's weather brings, it is almost a certainty that more companies will be recording it—for profit.

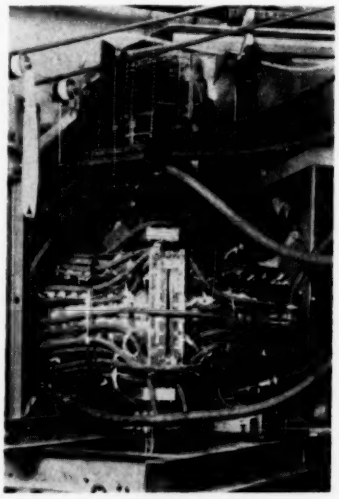
Fusion Brings Need For Tougher Linings

Trailing the flood of announcements on U. S. and British fusion research (*Chem. Eng.*, Feb. 24, 1958, p. 70) are some tricklings of more immediate interest to chemical engineers.

Biggest problem in construction materials, Britain's Harwell researchers expect will be linings for the torus which contains the hot gas at 5-6 million C. and higher. Hot deuterium gas tends to scrub and pit the torus walls at beginning and end of each pulse, apparently leaves one pit per pulse.

At present, Britain's Zeta (Zero Energy Thermonuclear Apparatus) uses aluminum liners. Other liners shown to Harwell visitors include highly polished stainless steel and aluminum sprayed with a film of refractory material.

According to Harwell, pitting of the walls is aggravated by arcing between gas and torus wall, causing indents deep enough to penetrate oxide film of the liner. The main problem is to find a film thick enough to give arcing protection but thin enough to withstand thermal shock.



Add Sceptre III to Perhapsatron, Zeta

Barely noticed in the thermonuclear clamor over Perhapsatron and Zeta (*Chem. Eng.*, Feb. 24, 1958, p. 70) was Britain's Sceptre III, above.

As long ago as last November, at a two-day meeting of the British Physical Society, scientists working at Associated Electrical Industries' Aldermaston labs claimed to have initiated a thermonuclear reaction in Sceptre III. Work on U. S. Perhapsatron and British Zeta wasn't reported until January of this year.

Sceptre researchers flicked 300,000-amp pulses through heavy-hydrogen "plasma" in a 12-in.-bore torus of 45-in. mean dia.

AEI fusion team head, T. E. Allibone, predicts that the hydrogen fusion process will be sound engineering practice in 10 years.

Emery NEWS

WEIGHING SYSTEM

BIN, TANK AND HOPPER EDITION No. 8

Covering design, development and application data on Emery Weighing Systems for industrial applications.

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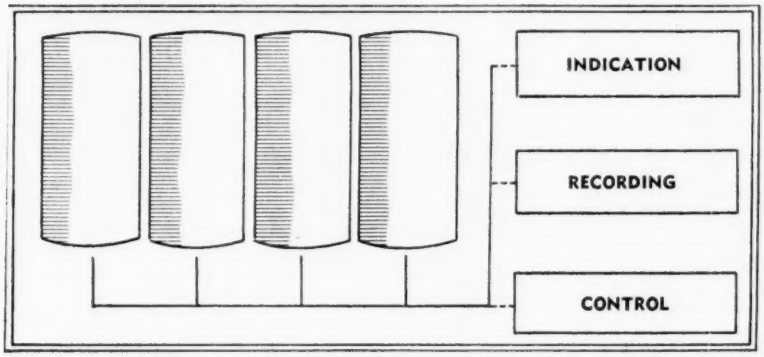
Whether you want simple indication, recording, combination indication and recording, simple or complex control, or a variety of printed forms, investigate the possibility of using the usually less expensive and easily the most simple tank weighing system available today.



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THE A. H. EMERY CO. PRECISION SINCE 1872 FORCE MEASUREMENT

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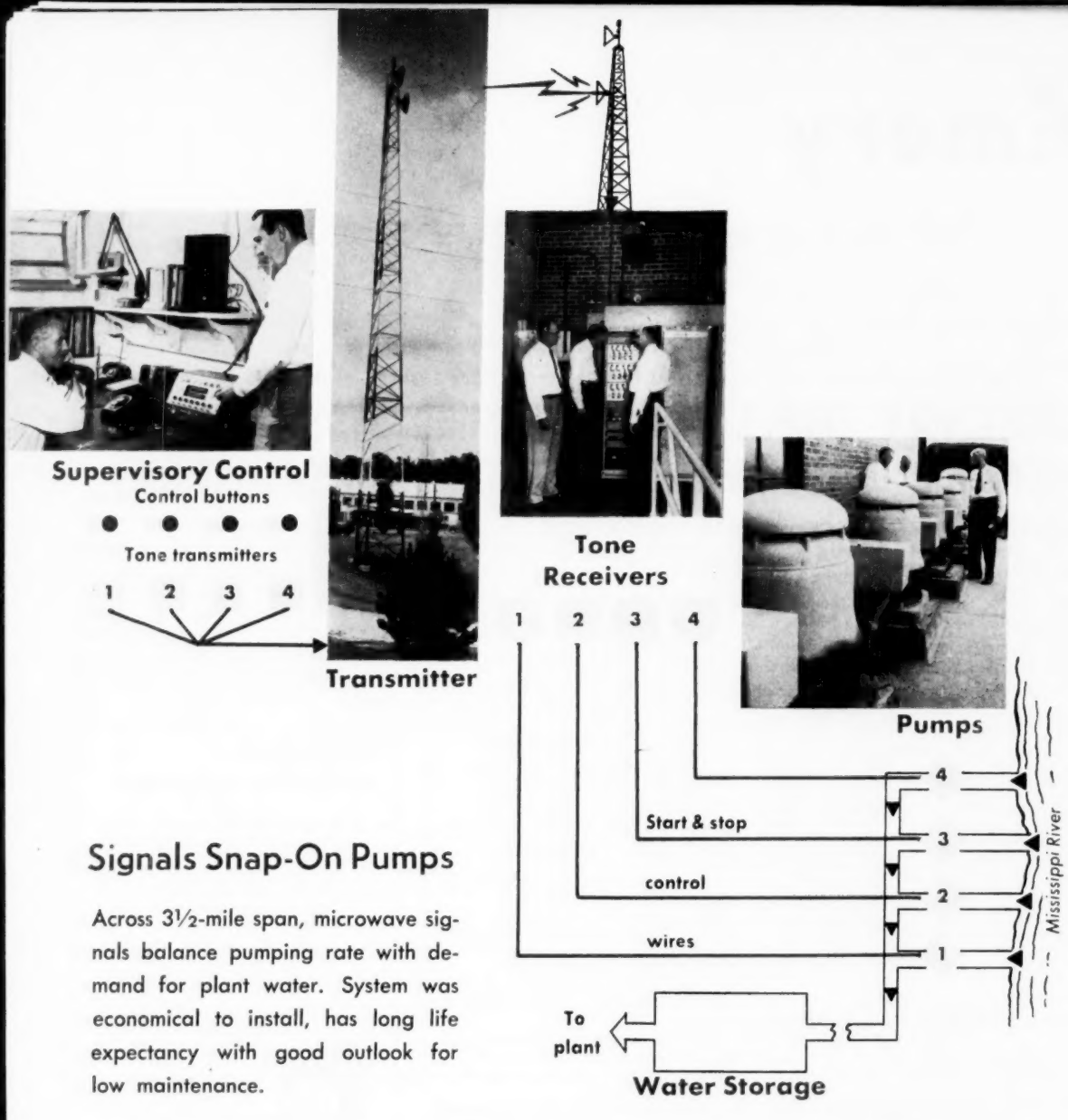
Pine Street • New Canaan, Conn.



Signals Snap-On Pumps

Across 3½-mile span, microwave signals balance pumping rate with demand for plant water. System was economical to install, has long life expectancy with good outlook for low maintenance.

Microwave Controls Supply of Plant Water

Olin Mathieson Chemical Co. now controls the supply of water for its East Alton, Ill., filtration plant by microwave radio. Installed under an FCC license* by General Electric's Communication Products Department, it is the first industrial setup of its type in the nation.

The system pumps up to six million gallons of water daily from the Mississippi River to the plant—three and a half pipeline miles away.

It's all done by remote control. An operator at the plant transmits various combinations of tones, by high frequency radio energy, to start and stop pumps at the river's edge. Water, thus brought to the plant, services three Olin divisions—Western Brass Mills, Winchester-Western, Explosives—largely for cooling purposes.

► **Olin's Needs**—Because there is no reservoir of water at the filtration plant—only a storage tank—the control system must respond in a wink as the tank's supply decreases. There is no regular "down" period at the plant; it operates 24 hours a day, seven days a week. An interruption in the water supply of say a half hour could really throw a wrench into production schedules. What Olin needs, above all, in its control system, therefore, is absolute and split-second responsiveness.

And, the old control system just didn't measure up. It used pole-perched wire-line cables to

* Olin's operation is listed by the Federal Communication Commission in a special industrial radio category; but it is the first in the category to license microwave.

transmit signals to the pump station, with these decided drawbacks:

• River flood conditions created quite a hazard in servicing the wire lines.

• Poles for the cables were highly vulnerable to weather conditions, because of their location near the river's flood area.

• Maintenance was no cinch because linemen (the checkers) had to walk the entire length of the wires—a 3½ mile zigzag, partly through thick woods—to check the system.

▶ **Why the New System**—With microwave, on the other hand, there are no wooden poles to warp and no wires to service and check. Microwave's steel towers will stand much longer than the 15-year life of the poles. Furthermore, Olin engineers predict that the equipment for the entire system will be easily maintained; they'll have to replace only small components, from time to time.

What's more, they say that, as a whole, the microwave system costs about 20% less than the amount needed to put up the cable-type control.

That's why, when the opportunity presented itself, (i. e. the old system's 15-year-old poles had to be replaced) Olin engineers jumped at the chance to find a better system.

▶ **Microwave Setup**—A control board operator keeps tabs on the supply of water in the storage tank at the filtration plant—the dispatch terminal. When the tank's supply reaches a sufficiently low point, he pushes a tone-signal button on a desk-mounted console connected to the supervisory control panel.

There are five different single tones which are always used in specific combinations of two, so that extraneous noises won't easily trigger an unwanted response. However, should such a response occur, an alarm on the supervisory control board warns the operator immediately.

Microwave tone-impulses are transmitted from a tower at the dispatch terminal to another tower at the remote (river) terminal. The microwaves (very high frequency waves of 900 megacycles or above) travel, characteristically, in line-of-sight paths through the air. Specifically, they're transmitted between large, metal, saucer-like disks on towers.

When the tone-impulse is received at the remote terminal, microwave equipment swings one or more of the motor-driven pumps into action and sends the needed water out through the steel pipeline. Tone-impulses also operate indicator lights on the operator's control board. These automatic return signals tell him exactly what happens at the remote station.

To simplify maintenance, a handy two-way voice circuit is also made possible by microwave equipment. Emergency duplicate equipment also stands ready to swing into action automatically—should any real trouble develop along the line.

News Briefs

Rockets: Thiokol Chemical Co. plans a $750,000 to $1-million expansion of its Brigham City, Utah, facilities for manufacturing and testing of solid-fuel rocket engines.

Fiber-glass yarn: Pittsburgh Plate Glass Co. has now broken ground for a multimillion-dollar continuous fiberglass yarn plant at Shelby, N. C.; new 16-glass-furnace plant will spin out 25 million lb./yr. of yarn.

Polyethylene: National Petrochemicals Corp. has just started construction on its 75-million-lb./yr. polyethylene plant at Houston, Tex.

BTX: Ashland Oil & Refining Co. has set the middle of this month as on-stream date for its new 21-million-gal./yr. aromatics plant at Buffalo, N. Y. Unit will make benzene, toluene, xylene and heavier aromatics.

Synthesis-gas process: Shell Chemical will construct a new unit at its Shell Haven site in England to process 200 tons/day of heavy fuel oil, via a new route, to make synthesis gas used in producing nitrogen fertilizers. With liquid or gaseous hydrocarbons, noncatalytic process operates at high pressure with enriched air or oxygen to turn out gas high in hydrogen and carbon monoxide.

Convention Calendar

American Chemical Society, 133rd national meeting, San Francisco, general assembly—April 14, Nourse Auditorium, San Francisco, Calif., April 13-18.

American Society of Mechanical Engineers, Maintenance & Plant Engineering Conference, Penn-Sheraton Hotel, Pittsburgh, Pa., April 14-15.

Design Engineering Show, International Amphitheatre, Chicago, Ill., April 14-17.

American Zinc Institute, 40th annual meeting, Chase-Park Plaza Hotels, St. Louis, Mo., April 14-15.

Lead Industries Assn., 30th annual meeting, Chase-Park Plaza Hotels, St. Louis, Mo., April 15-16.

American Electroplaters Society, 4th annual, Empire State Regional Conference, Hotel Manger, Rochester, N. Y., April 19.

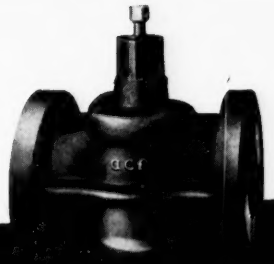
Joint Conference, American Institute of Chemical Engineers and Chemical Engineering Subject Div., Chemical Industry of Canada, Sheraton-Mt. Royal Hotel, Montreal, Canada, April 20-23.

American Institute of Chemical Engineers, Sheraton-Mt. Royal Hotel, Montreal, Canada, April 20-23.

Scientific Apparatus Makers Assn., 40th annual meeting, El Mirador Hotel, Palm Springs, Calif., April 20-24.

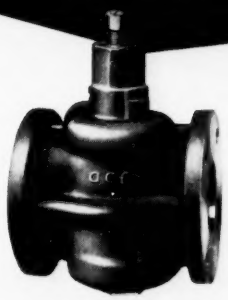
National Industrial Research Conference, Conrad Hilton Hotel, Chicago, Ill., April 20-24.

American Oil Chemists' Society, spring meeting, Peabody Hotel, Memphis, Tenn., April 21-23.



HOW TO JUDGE A LUBRICATED PLUG VALVE

for efficient, economical chemical service . . .



1 Does it permit full flow?
acf Round or Rectangular Port Lubricated Plug Valves do. In any given size the Round Port Valve has a plug port diameter and area the same size as the pipe. The Rectangular Port, while of different shape, has the same Port area as the inside area of the pipe with which it is used.

2 Does it have quick on/off control?
A quarter-turn (90°) opens or closes acf Lubricated Plug Valves. The lubricated, cylindrical plug turns as smoothly and easily as a journal in a bearing.

3 Does it shut-off tight?
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acf Lubricated Plug Valves stay in service long after their original low first cost has been written-off. They require little or no maintenance. Minimum number of parts and easy dismantling make repairs simple and quick when necessary.

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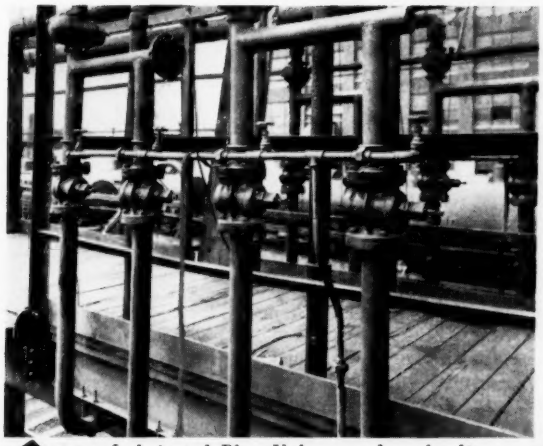
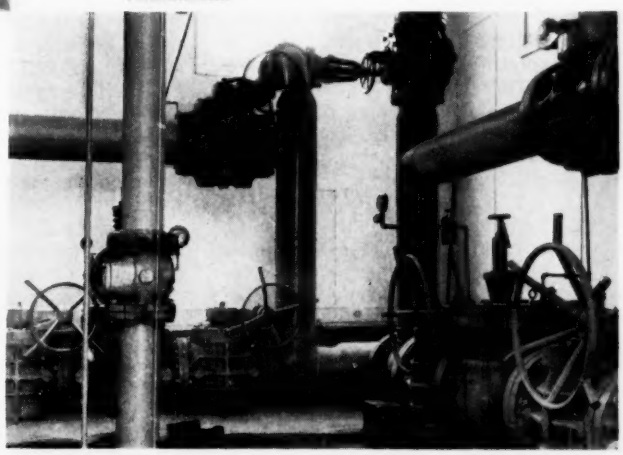
acf Lubricants are available for a wide range of corrosive services. acf Valves are available in Semi-Steel, Carbon Steel, Ni-Resist, Bronze and Aluminum.



acf Lubricated Plug Valves used on loading rack handling different types oil and greases.

acf 2" through 12" Lubricated Plug Valves in process lines in potash plant.



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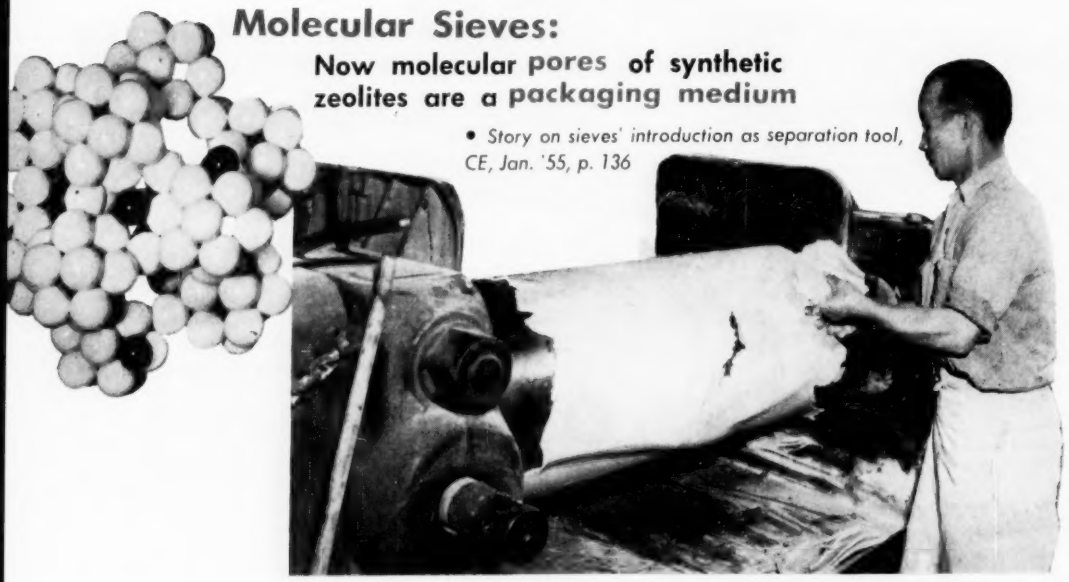


Molecular Sieves:
Now molecular pores of synthetic zeolites are a packaging medium

• *Story on sieves' introduction as separation tool, CE, Jan. '55, p. 136*

TO CURE silicone rubber: volatile catalyst within sieves within paste.

Molecules Switch From Sieving to Containing

Linde's zeolites, established as separation tools, have now branched into packaging.

How it successfully "caged" a volatile, liquid catalyst used for curing vinyl silicone rubber so that it could be marketed in a convenient paste form has just been revealed by Union Carbide's silicones division.

The catalyst, di-tertiary-butylperoxide, is too volatile for safe, easy handling and storage under ordinary conditions. To solve the problem, the company perfected a method for absorbing the liquid onto a Linde Molecular Sieve. The sieves were loaded with fifteen weight-percent DTBP and were then compounded with the company's W-96, a vinyl-containing silicone gum stock.

The resulting stiff white paste, introduced early in 1956 as X-1960, is said to simplify curing of large masses of silicone rubber by allowing a one step postcure. Previously needed: a long scheduled step cure.

This is the first commercial use of Linde Molecular Sieves as carriers of catalytic materials. Synthetic crystalline zeolites, they have outsanding absorbent qualities. Since their introduction in 1954, they have had considerable use as selective adsorbents.

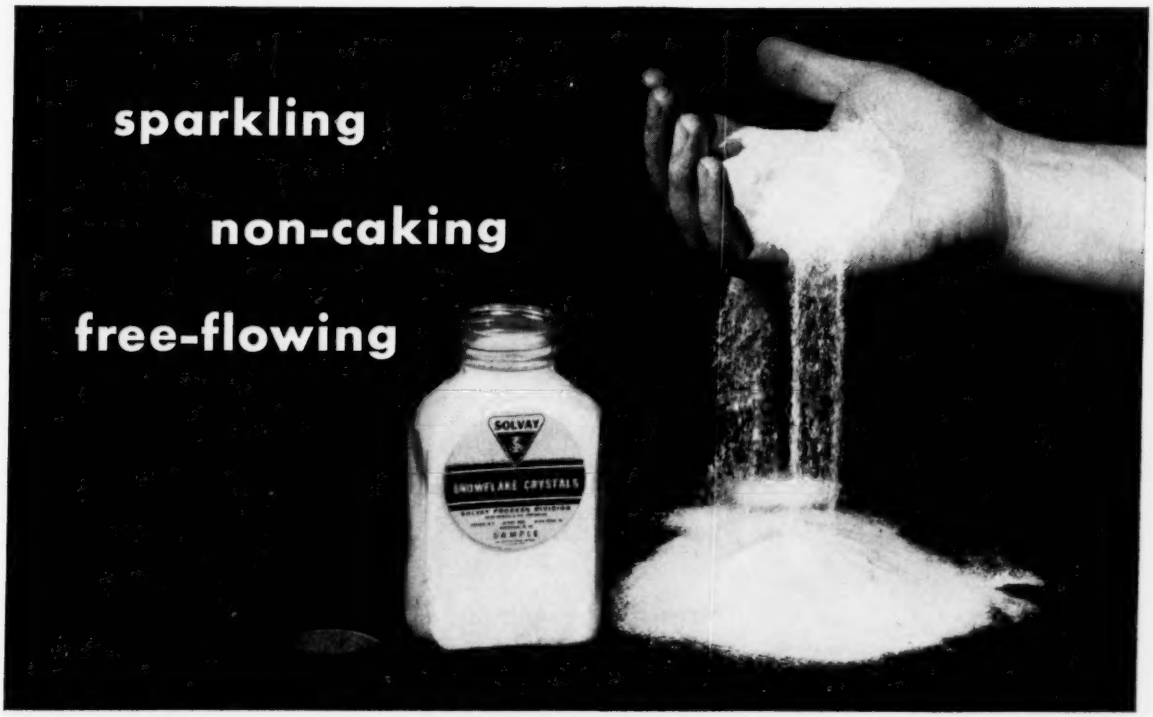
These zeolites present to a mixture of chemicals a surface systematically dotted with holes of equal molecular diameters. Molecules small enough to fit through the holes are adsorbed, molecules too big are thrown off. They can separate straight-chain aliphatics from either branched-chain or cyclic aliphatic, or from aromatics, on the basis of their respective physical contours.

Attractive forces, acting on the molecules which do get through produces additional screening action. Components most strongly attracted tend to remain within the crystal longer.

Made to serve their new function as a carrier is their ability to retain the adsorbed material with small losses at storage temperature. At effective rubber curing temperatures, their catalyst load is released almost 100%.

For this application, the alumino-silicate composition of the sieves is particularly well suited because it allows incorporation in silicone rubber compounds with no detrimental effects.

Molecular Sieves are not new chemically. Certain naturally-occuring zeolites have similar properties but are too scarce to serve as commercial chemicals.—**Silicones Div., Union Carbide Corp., New York, N. Y. 72A**



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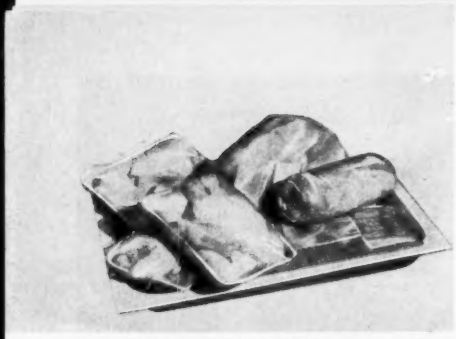

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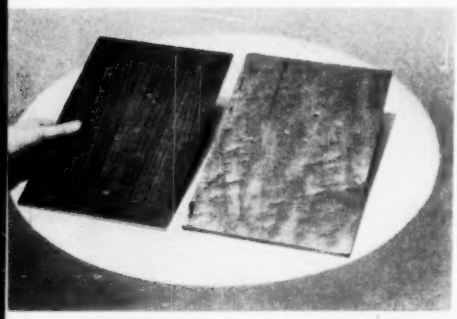

Polyester Film

Heat and pressure make it stick; no adhesive needed.

A new polyester film, called Videne, is said to possess many unusual properties, including the ability to adhere and seal without use of adhesives. Already available in pilot plant quantities, it will be in commercial production by spring of 1959.

The product will be marketed in two forms: Videne A and Videne TC. The former is an unoriented film 0.002 to 0.0075 in. thick suitable for protective and decorative laminations. It can be stretch laminated to a thinner film. Videne TC is an oriented film aimed at packaging applications.

The product is said to have good aging and abrasion resistance, good dimensional stability and a controlled gloss factor on the finished products.

The laminating film can be adhered under heat and pressure to textiles, metals, wood, paper and certain plastics without adhesives and will vacuum form or draw to the limits of supporting materials. It can also be laminated to glass, fabric, cotton, wool, Dacron, Orlon, nylon and Vinyon fabrics without adhesives.

Some successful uses that test marketing has thus far turned up: it improves abrasion resistance of decorative wall panels and also of aluminum products, improves outdoor aging characteristics of high impact styrene.

The packaging film, Videne TC, has unusual strength in an unsupported state plus good transparency or clarity. It has high resistance to abrasion and breakage and enough inherent rigidity and dimensional stability to be run on commercially available automatic packaging machines. — **Goodyear Tire & Rubber Co., Akron, Ohio. 74A**

Beta-Propiolactone

Intermediate, adhesive stabilizer, textile chemical, sterilizer.

First commercial qualtities of beta-propiolactone are now available.

Its potential as a chemical intermediate embraces amines, alcohols and other compounds containing active hydrogen. It is used to improve stability of starch-derived adhesive and in the synthesis of acrylic acid and acrylates. It is also reported to modify textile fibers to improve hand and other properties.

Effective for area and surface decontamination, it is said to be an excellent sterilizing agent for biologicals because of its capacity to inactivate a wide variety of bacteria, fungi and viruses. The Army Chemical Corps announced recently (*Chem. Eng.*, Mar. 24, 1958, p. 60) that its scientists, in experiments at Fort Detrick, Md., had disinfected entire hospital building as well as electronic apparatus and transportation equipment by using the gaseous form of beta-propiolactone.

For such experimental uses under proper conditions, the manufacturer can produce a specially purified grade of beta-propiolactone. Prices for manufacturing grade is 87¢/lb. in tank care lots.—**Celanese Corp. of America, 180 Madison Ave., New York, N. Y. 74B**

Silicones

Two new fluids, two new resins.

Within recent weeks, the General Electric silicone products department has introduced two new silicone fluids and Union Carbide's silicones division has brought out two new silicone resins.

A new low viscosity silicone fluid has been suggested for use as a damping medium in vibration dampers, shock absorbers, dash pot relays, and as a hydraulic fluid in servomechan-

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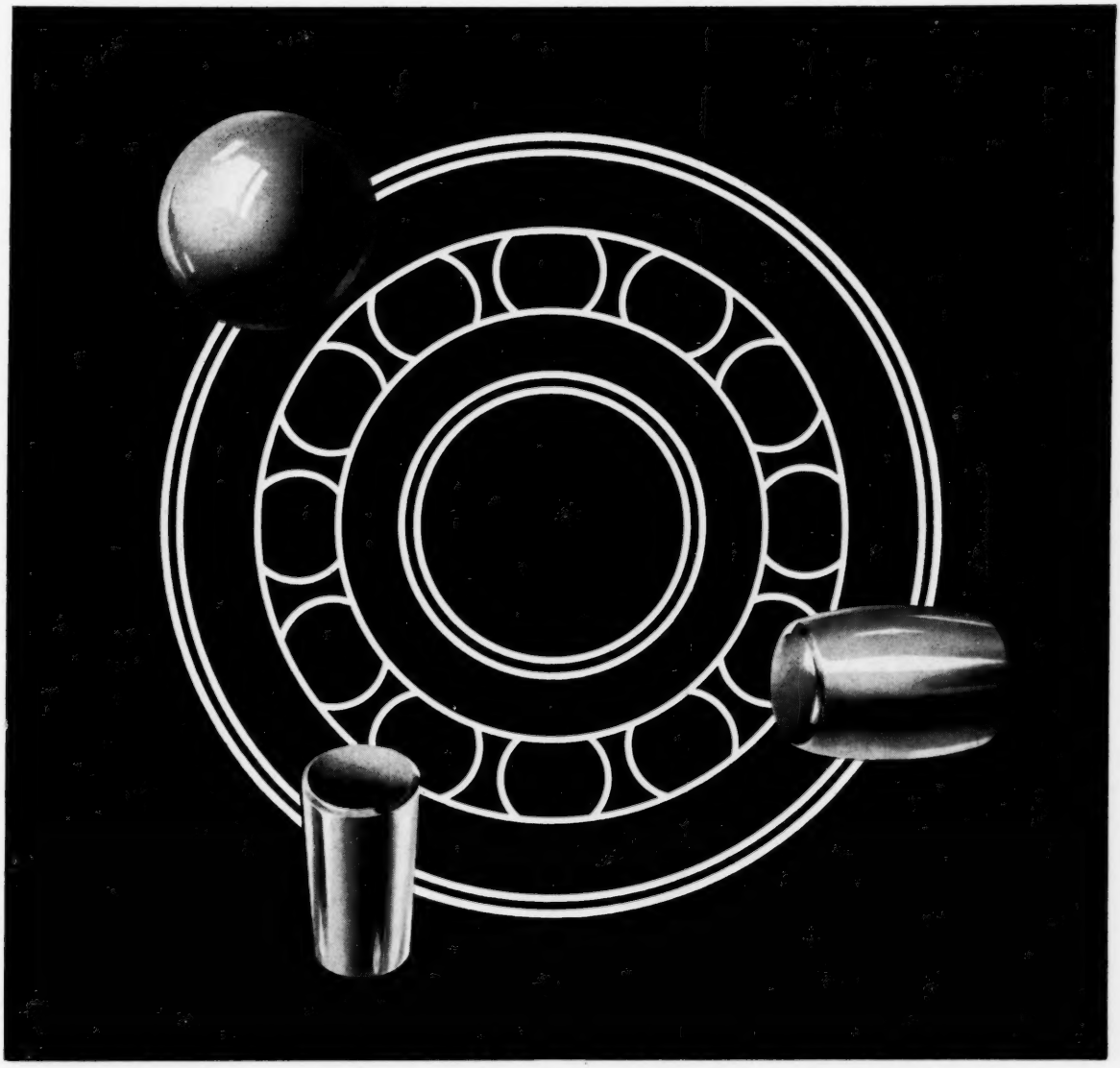

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Nebula EP – another first for Esso Research – is a multi-purpose grease that *out-performs* all other multi-purpose greases. And many specialized greases as well!

Nebula EP works exceptionally well in ball, tapered roller and roller bearings – of *all sizes* from rolling mills to precision instruments.

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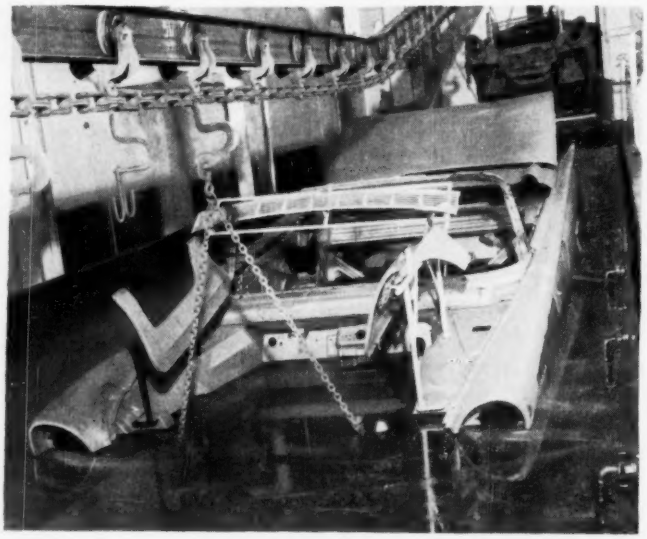

Water-Base Paint Gets First Use in Auto Body Priming

Lincoln, using a latex dip for all of its 1958 models, is the first automotive manufacturer to make such use of water-emulsion paints. Elimination of the fire hazard present in dipping operations involving solvent-thinned materials is one of the principal reasons for the move.

Lincoln's unitized bodies, new with the '58 models, required dip tank treatment in order to coat completely the inner surfaces of the body. A spray system to do the same job would be prohibitively complicated. But the 9,000-gal. dip tank required would create fire hazard if filled with solvent-thinned paint. — Ford Motor Co., Detroit, Mich. 76A

isms, acceleratometers and instruments. Available in 5, 10 and 20 centistoke grades and called fluid 81743, it offers more rapid response than standard silicone fluids of higher viscosities.—**General Electric Co., Waterford, N. Y. 74C**

A new methyl phenyl silicone fluid is suggested for use as a heat transfer medium in thermostatic controls and in high temperature, instrument calibration and oil sterilization baths. It will withstand more than 1,000 hr. exposure to air at 250 C. without decomposition or gelling. Designated 81705, it can be used for applications over the temperature range of −40 to 500 F.—**General Electric Co., Waterford, N. Y. 74D**

A silicone resin especially designed for cold-blending with alkyd, melamine and acrylic type baking enamels to give them improved color and gloss retention, thermal stability and resistance to weathering has been developed. Designated R-64, it is expected to find use as a base for aluminum paints to operate at 500 to 1,200 F.—**Silicones Div., Union Carbide Corp., New York, N. Y. 74E**

For electrical insulation applications, new XR-70 silicone resin differs from conventional silicone resins in that it is 100% reactive, eliminating the need for a solvent removal step during cure. This in turn makes possible thick sections of void-free, corona-resistant, high temperature (180 C.) insulation. It is especially suited for vacuum impregnating form-wound coils with mica or glass cloth-mica insulation for operation at Class H temperatures. — **Silicones Div., Union Carbide Corp., New York, N. Y. 74F**

BRIEFS

240 F. polyethylene, a high-density material called Boltathene, is said to retain its shape when placed in contact with boiling water and to resist cracking, shattering or brittleness at low temperatures.—**General Tire & Rubber Co., Lawrence, Mass. 76B**

Foaming polystyrene beads that can expand in place to the size of their container are being marketed under the trademark, Pelaspan. They are already being used as insulation in the doors of a 1958 line of refrigerators. — **Dow Chemical Co., Midland, Mich. 76C**

Vanadium oxytrichloride, a new catalyst with promise for polymer production, is now in commercial production.—**Anderson Chemical Co., Weston, Mich. 76D**

Asbestos fiber materials, new to reinforced plastics, are said to show higher moduli than other reinforcing materials, highest chemical resistance of any existing fiber, exceptional heat resistance and excellent electrical properties. The materials are Crocidolite and Amosite asbestos and are included in reinforced products known as Noramite.—**North American Asbestos Corp., Chicago, Ill.; Product Techniques, Inc., Hudson, Ohio. 76E**

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Reader Service

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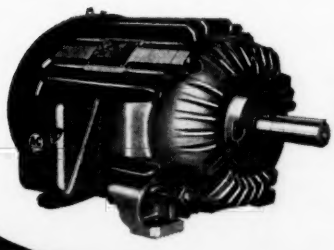
- Ribbed cast-iron frame has large cooling surface, protects against physical damage.
- Bearings are double-shielded to control grease migration, prevent overgreasing — and grease *stays out* of motor interior.
- Special safeguards for corrosive applications include: liberal use of cast iron, Parkerized hardware (including hexhead cap screws).
- Double insulation makes stator electrically tough. Polyester film guards windings in slot, cambric strips protect windings phase to phase, multiple dips and bakes of insulating varnish do the job.

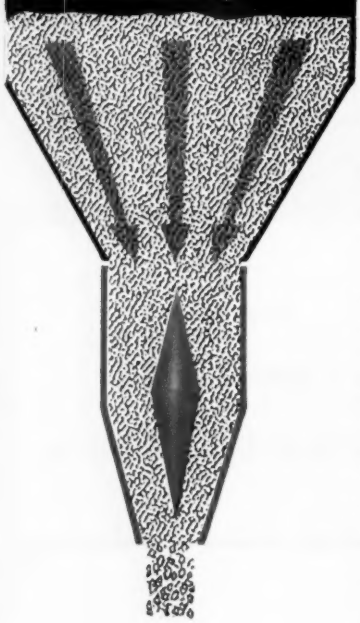
For the long-run power, contact your A-C district office or distributor, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.



ALLIS-CHALMERS

A-5649

Hopper-Cone Device: Gives even flow of solids; eliminates ratholes, high pressures and adhesion to hopper walls.



Plug Unplugs Flow From Bins

New hopper for bins falls into category of "a cure by the hair of the dog that bit you." A special plug in center of outlet prevents stoppage, permits easy control.

To use a slang phrase, reliance on a plug to improve the flow of solids from a storage-bin outlet seems "off-beat." Yet, at first glance, that seems to be the course adopted by engineers at Bituminous Coal Research, Inc., Columbus, Ohio.

Actually, F. D. Cooper, J. R. Garvey and associates at BCR use the plug to form an annulus within a new discharge hopper. Solids move more freely through this annulus, without jamming into a stoppage.

▶ **One Solution to Many Problems** — As you would expect, BCR's interest in this problem aims at solving stoppage problems encountered in coal bins, particularly when the coal is fine and moist. But, the Easy-Flo bin developed by BCR is proving equally good at eliminating discharge jam-ups that arise in handling other bulk solids.

At midwinter, 12 different companies were actively considering installation of Easy-Flo hoppers. At its Avery Island, La., plant, International Salt Co. was starting erection of a 16-ft.-dia. by 60-ft.-high concrete bin with a built-in Easy-Flo hopper designed to handle fine salt.

▶ **Development Not Finished** — While the foregoing might indicate that the Easy-Flo is fully developed, BCR feels that it still has much to learn about the capabilities of the device. Full-scale testing started early this winter at BCR's Columbus laboratory, but has been hampered by bitter winter weather.

Initially, BCR worked out the elements of this development on a 3-ft.-dia. by 4-ft.-high vertical section which could be modified with different hopper configurations. At present, tests are proceeding on a 10 x 40-ft. concrete-stave silo designed especially to provide extreme conditions.

Further work on the Easy-Flo aims to explore applications with various bin configurations, outlet locations, and types and conditions of solids.

▶ **What Causes Poor Flow?** — Basic work at BCR revealed that storage bins discharge poorly because solids at the bins' center move downward as a solid core during discharge. This causes ratholes, high pressures and adhesion of solids to the hopper walls.

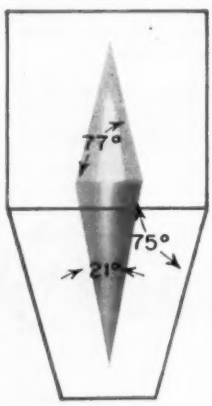
In order to make solids discharge well, BCR finds it necessary to eliminate this central core. Then, pressures on the hopper walls are uniformly low, and material throughout the entire bin and hopper moves much like water in a tank that is draining.

▶ **Enter, the Plug** — BCR's answer to the central-core problem is to insert a double-cone plug or deflector in the hopper, directly above the outlet. Material moving down into the hopper must slip through the resulting annular space next to the walls—the tapered plug blocks the center.

For coal, optimum plug shape has proven to be that shown in the sketch. The cap cone slopes at 77 deg. for a 75-deg.-sloped hopper. Using this arrangement, BCR has discharged, without difficulty, ¼ x 0-in. coal containing 15% surface moisture. Other recent successful tests covered fly ash ranging from 16 to 45% moisture content.

▶ **In Professional Hands**—Easy-

Optimum Cone Shape: Sketch below shows proper angles for coal-bin hopper.



Tri-Sure Plant at Sao Bernardo Do Campo, Estado de Sao Paulo, Brazil

Tri-Sure® Plant in Brazil

gives South American shippers the security of *Tri-Sure*® *Closures on drums and pails*

The modern Tri-Sure* plant in Sao Paulo, Brazil, brings to petroleum, chemical, food and other shippers in drums and pails the advantages of Tri-Sure protection.

The plant is now producing Tri-Sure Flanges, Steel Plugs, Zinc Plugs, Tab-Seals, flange insertion dies and tools for drum closures, Tri-Sure Straight Reversible Spout Assemblies for pails, and dies for 55MM openings in light containers.

Ideally located for sales-engineering service to Tri-Sure closure users, the Sao Paulo plant has become a strong link in "Tri-Sure the World Over," teaming up with nine other Tri-Sure plants and affiliates in providing *quality protection* for *quality products.*

Wherever your plant is located, there is a Tri-Sure plant to serve you. And wherever your products are shipped, there are Tri-Sure Closures that will exactly meet their needs. Send for full details on the complete Tri-Sure line.

Always specify

Tri-Sure

Reg. U. S. Pat. Off.

CLOSURES

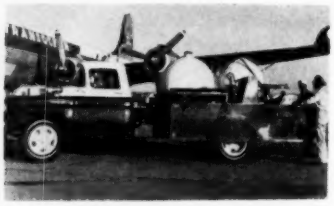
*The "Tri-Sure" Trademark is a mark of reliability backed by over 35 years serving industry.

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

CHICAGO, ILL. · LINDEN, N. J. · NILES, OHIO

Tri-Sure Products Limited, St. Catharines, Ontario, Canada
Tri-Sure S/A Indústria e Comércio, Sao Bernardo Do Campo, Estado de Sao Paulo, Brazil
American Flange & Manufacturing Co. Inc., Villawood, N. S. W., Australia
Compañia Mexicana Tri-Sure S/A, Naucalpan, E. de Mexico, Mexico
B. Van Leer N. V., Stadhouderskade 6, Amsterdam, Holland
Van Leer Industries, Ltd., Seymour House, 17 Waterloo Place, Pall Mall S. W. I, London, England

Flo bin attachments will be available only through licensed manufacturers that already are well established in the materials-handling field. That's because skilled engineering and know-how are considered essential to apply this device successfully. International's installation is in the hands of Neff & Fry Co., Camden, Ohio. — **Bituminous Coal Research, Inc., Pittsburgh 13, Pa.** 78A



Fire Fighter

Portable unit enables use of wet or dry chemicals.

Designed originally for major oil-field fires, the Fire Boss is expected to find widespread application as a prime agent for industrial damage control.

Fire Boss consists essentially of two spheres, one filled with 1,500 lb. of powdered chemicals under nitrogen pressure, and the other with water. The water plus chemicals in auxiliary tanks provide eight different assisting agents to the dry powder. These include any combination of either fog or straight streams of water, foam, wet-water or wet-water foam.

Neoprene hoses, mounted on continuous-flow reels, are always ready for instant use. Although one man can handle the unit, two to four operators are recommended.

The complete unit comes mounted on either a truck trailer or skids. — **Fire Boss, Inc., West 2nd St., Odessa, Tex.** 80A

Pressure Screen

Cleans up feed stock to high-speed paper machines.

High capacity and low power consumption head up the list of advantages for the new Centiscreen pressure screen. Coupled with these are simplicity of installation, operation and maintenance.

Stock feeds into an annulus formed by two circular screens. Pulsating action produced by two pairs of rotating hydrofoils drives acceptable stock through the screens and into a discharge line. Splinters not thoroughly reduced in cooking and bleaching are retained, and leave the machine through a tailings discharge line. Heavier particles of dirt are trapped even before they reach the screens. — **Bird Machine Co., South Walpole, Mass.** 80B

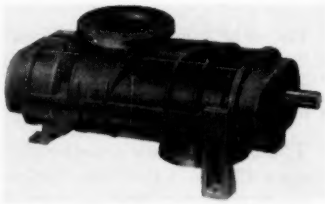
Plastic Solenoid Valve

Designed to handle most corrosive fluids.

Company officials claim that the new SV-5100 series of all-plastic, corrosion-resistant solenoid valves will outlast their stainless steel counterparts 100 to 1.

Made of molded nylon, the valve may be taken apart for inspection and cleaning without removing it from the line. Fittings, which are an integral part of the molded body, are designed for ⅜-in. I.D. slip-on plastic tubing.

Capacity at its rated maximum operating pressure of 7 psig. is 4 gpm. Maximum current drain is 10 watts.—**Valcor Engineering Corp., Kenilworth, N. J.** 80C



Blower-Compressor

Eight models offer wide service range.

Newly designed for either pressure or vacuum service, the Cycloblower line of axial-flow blower-compressors will handle air, steam or various process gases.

Direct or step-up drives for the mating pair of screw rotors enable the use of standard motors for power input. Special compressor chamber design permits increased water rates for wet compression and vacuum service.

Eight models, providing a capacity range from 100 to

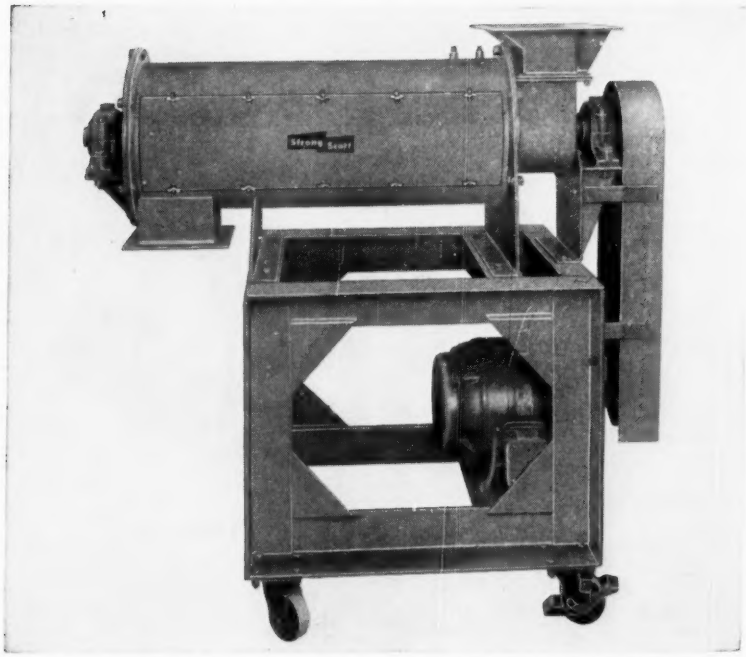
Equipment Developments

Page number is also Reader Service Code number

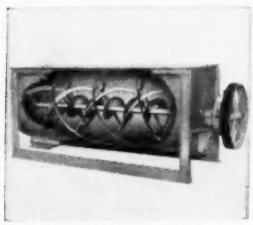
For more details, use Reader Service Card

NEW PRODUCT NEWS

NEW HIGH SPEED MIXER FOR QUALITY FINISHING

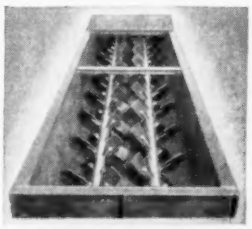


The Turbulizer produces a homogeneous mix, increases production while reducing mixing time and costs.



TRIPLE ACTION MIXER—Complete uniform blending in 2 to 7 minutes.

STRONG-SCOTT TRIPLE ACTION MIXER exposes each particle in the mixture to over 10,000 separate mixing actions per minute as it blends and folds. This produces a uniformly mixed product with 99.9% thorough distribution of minor additives.



TWIN ROTOR MIXERS—Accurate blending of liquids and dry mix at any speed.

TWIN ROTOR MIXERS are designed primarily for high percentages of liquid application to light weight ingredients, where product identity is to be maintained. A double shaft assembly with overlapping, adjustable paddles gently combine the liquids with the dry mix.

STRONG-SCOTT TURBULIZER

Provides Fast, Thorough Dispersion, Disintegration and Blending of Dry Materials, or Pastes Involving Liquids and Solids.

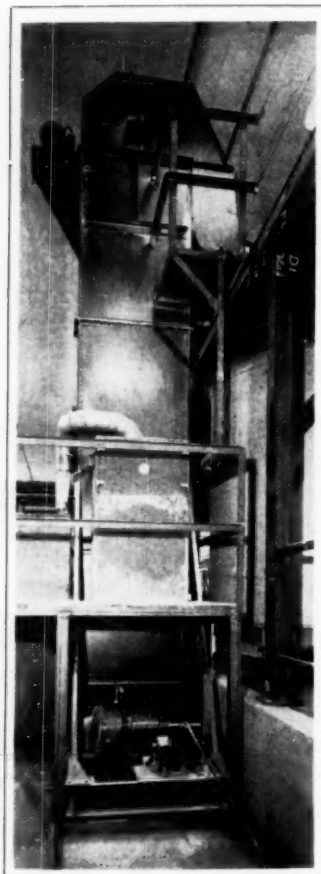
The TURBULIZER is a high speed, continuous mixer that will disintegrate and disperse fat pellets, chemical ingredients which have a tendency to ball or agglomerate, and other ingredients which can be broken by the paddles and thoroughly dispersed in the mixture. Product uniformity is accurately maintained as a result of high speed centrifugal forces created by the paddles.

It is also highly applicable where a fluffing action is desired on powdered material. Minor percentages of liquid may easily be added to dry mix with high efficiency and dispersion results.

The TURBULIZER is self cleaning and is built with sanitary seals at each end of the shaft. The interior is precision machined. Overlapping, adjustable paddles turn within a close tolerance to the chamber wall, providing a selective rate of material flow.

The TURBULIZER may be furnished in carbon or stainless steel and may be jacketed for hot water, steam or a refrigerant. Capacities will vary depending on the bulk density of the material and the degree of agglomerates encountered. Consult Strong-Scott for full details.

nearly 3,500 cfm., are available. Pressure range offered is 3 to 15 psig., vacuum range from 5 to 20 in. Hg.—**Cycloblower Co., York, Pa.** 80D



Roving Bucket Elevator Services Reactor Line

This elevator-on-rails moves up and down a line of reactors, feeding them a bulk diet of 9 ton/hr. of dichlorophenoxyacetic acid. The reactors are part of American Chemical Paint Co.'s weed killer and plant hormone facilities at St. Joseph, Mo. Having 50 ft. of travel, the unusual loader consists of a Link-Belt Type 204 centrifugal-discharge bucket elevator mounted on a steel self-propelled carriage.—Link-Belt Co., Prudential Plaza, Chicago 1, Ill. 82A

Hot-Gas Washer

Single compact unit cleans dust-laden gases.

Less than 15 ft. high, and featuring utility at temperatures up to 2,000 F., a new single-unit washer effectively eliminates dust from hot gas streams venting to the atmosphere.

On entering the washer, dust particles in the gas stream are wetted by a water spray. Initial flow energy causes the wet particles to impinge on the surface of a pool of water—most dust is trapped.

A second impingement chamber removes remaining particles; a fan-induced draft imparts the necessary flow energy.

Units come equipped with manual or automatic sludge-removal systems. Capacity range is dependent on use.—**Lehigh Fan & Blower Div., Fuller Co., Catasaqua, Pa.** 82B

Powder Dryer

Tilting-tray device cuts powder blow-away losses.

Positive displacement of fine powder through a controlled drying environment without dust loss is the job of the new Turbo-Dryer.

The dryer consists essentially of a system of tilting trays stacked in annular fashion around a set of fans. The fans circulate drying medium over the powder on the trays.

As the stack rotates, a stationary cam gradually tilts the individual trays of each shelf, thus sliding the contents to the next lower shelf of trays.

Dryers now being constructed include field-erected equipment as well as a small packaged unit. — **Wyssmont Co., Inc., Long Island City, N. Y.** 82C

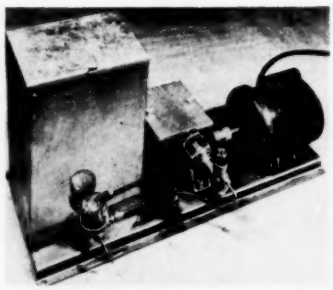
Plywood-Molded Pipe

Direct substitute for other types of pipes.

First introduced during World War II as a replacement for small-diameter metal pipes, versatile plywood pipe now offers lowest costs for many average and large-size piping jobs.

Two other desirable features, those of lightness and cutting simplicity, endow the pipe with ease of handling and installation.

Because the plywood product does not corrode, it has a much longer life than many other piping materials on the market. Plywood-molded pipes can be produced economically in any diameter, and lined with any material.—**Plycraft, Inc., Lawrence, Mass.** 82D



Additive Injector

Meters chemicals into high-pressure equipment.

Chief function of a recently developed pump is injection of measured quantities of liquid chemicals into process equipment under pressures up to 1,200 psi. Fitted with a special check valve, the pump will also withdraw measured samples from high-pressure lines.

A ¼-hp., 1,750-rpm. electric motor supplies motive power to the pump through a 50-to-1 reduction worm gear assembly. Each pump consists of one or two piston injectors, each capable of delivering from a few ounces to 40 gal. per day.

Normally, piston size and length of stroke provide adequate control of output rate. Variable speed motors will permit closer control if required.

Materials of construction for vital working parts include stainless steel, bronze or plastic. Three models are available —for line pressures of 250, 500 and 1,200 psi. Flow capacities vary inversely with head.—**Texsteam Corp., Div. of Vapor Heating Corp., 320 Hughes St., Houston 11, Tex.** 82E

Drum Handler

Lift-truck attachment assists drum handling.

A novel device, consisting of six 3-in.-dia. rams welded on a 130-in.-wide plate, enables standard Yale lift trucks to transport and stack five 55-gal. drums at a time.

Hangers and bolts fasten the attachment securely to the truck fork carriage. A slight pivoting action of the ram plate compensates for minor misalignment of truck and rams during pick-up.

The new drum handler will hoist up to 2,400 lb. at a 17-in. load center. It fits any model in Yale's lines of gas and electric-powered trucks.—**The Yale & Towne Mfg. Co., 11000 Roosevelt Blvd., Philadelphia 15, Pa.** 84A

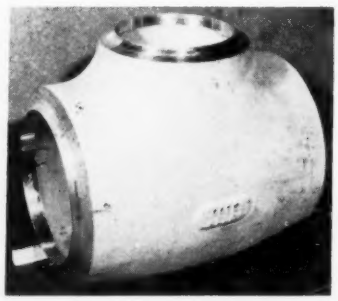
Precipitator Electrode

Replacement completely controls corona discharge.

Substitution of new "barbed-wire" energizing electrodes in place of conventional straight-wire types greatly increases the efficiency of electrostatic precipitators.

Straight-wire electrodes gradually accumulate an insulating coat of dust at various intervals along their length. As a result, concentration of corona at the clean portions eventually causes "flashover" to the collecting plates. The points on the barbs of the new wire remain clean, however, and corona remains evenly distributed.

Because of this even distribution, replacement of old electrode wire with new increases the capacity of existing precipitators; new precipitators equipped with the barb electrode need not be as large, for a given loading, as units fitted with conventional wire. — **Koppers Co., Inc., Metal Products Div., 490 Scott St., Baltimore 3, Md.** 84B



Stainless Fittings

Available in complete range of sizes.

A complete standard line of stainless-steel fittings is now available for service to 2,500 psi. at 670 F.

Fittings come in both 300 and 400 alloy series stainless steels. Ranging in size from 8 to 30 in., they include 45- and 90-deg. elbows, tees and reducing fittings. During manufacture, they must meet the strict quality controls required for nuclear applications as well as those in the chemical and petrochemical fields. — **Cooper Alloy Corp., Hillside, N. J.** 84C

BRIEFS

High-speed Votator filler packs canned goods at rates up to 1,000 containers/min.; combines processing and canning into a faster and more sanitary operation with lower maintenance. — **Girdler Process Equipment Div., National Cylinder Gas Co., Louisville, Ky.** 84D

Snap-in flowmeter tubes are feature of new 2700 Series Variable Area Flowmeters. Tube "floats" in a pair of O-rings, permits use of three meters for flow range normally covered by eight.— **Fischer & Porter Co., Hatboro, Pa.** 84E

Magnetic mechanical seals can replace conventional packing or spring-loaded mechanical seals in any stuffing box. Consisting of just two working parts held together by magnetic force, seal seats evenly at all times.—**A. W. Chesterton Co., Everet 49, Mass.** 84F

Roll-temperature thermocouples accurately measure surface temperature of rotating rolls, shafts and bearings. Units are adaptable to close-control systems because of fast response. — **Conax Corp., 2300 Walden Ave., Buffalo 25, N. Y.** 84G

Equipment Cost Indexes

	Sept. 1957	Dec. 1957
Industry		
Avg. of all	225.0	229.2
Process Industries		
Cement mfg	216.6	220.7
Chemical	226.6	230.4
Clay products	210.4	214.4
Glass mfg	214.0	217.6
Paint mfg	217.4	221.6
Paper mfg	218.3	222.0
Petroleum ind	222.0	226.3
Rubber ind	224.8	229.1
Process ind. avg	223.7	227.0
Related Industries		
Elec. power equip	229.8	232.9
Mining, milling	228.0	231.8
Refrigerating	254.0	258.9
Steam power	212.8	216.9

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124–6 for method of obtaining index numbers; Feb. 24, 1958, pp. 143–4 for annual averages since 1913.

For More Information . . .

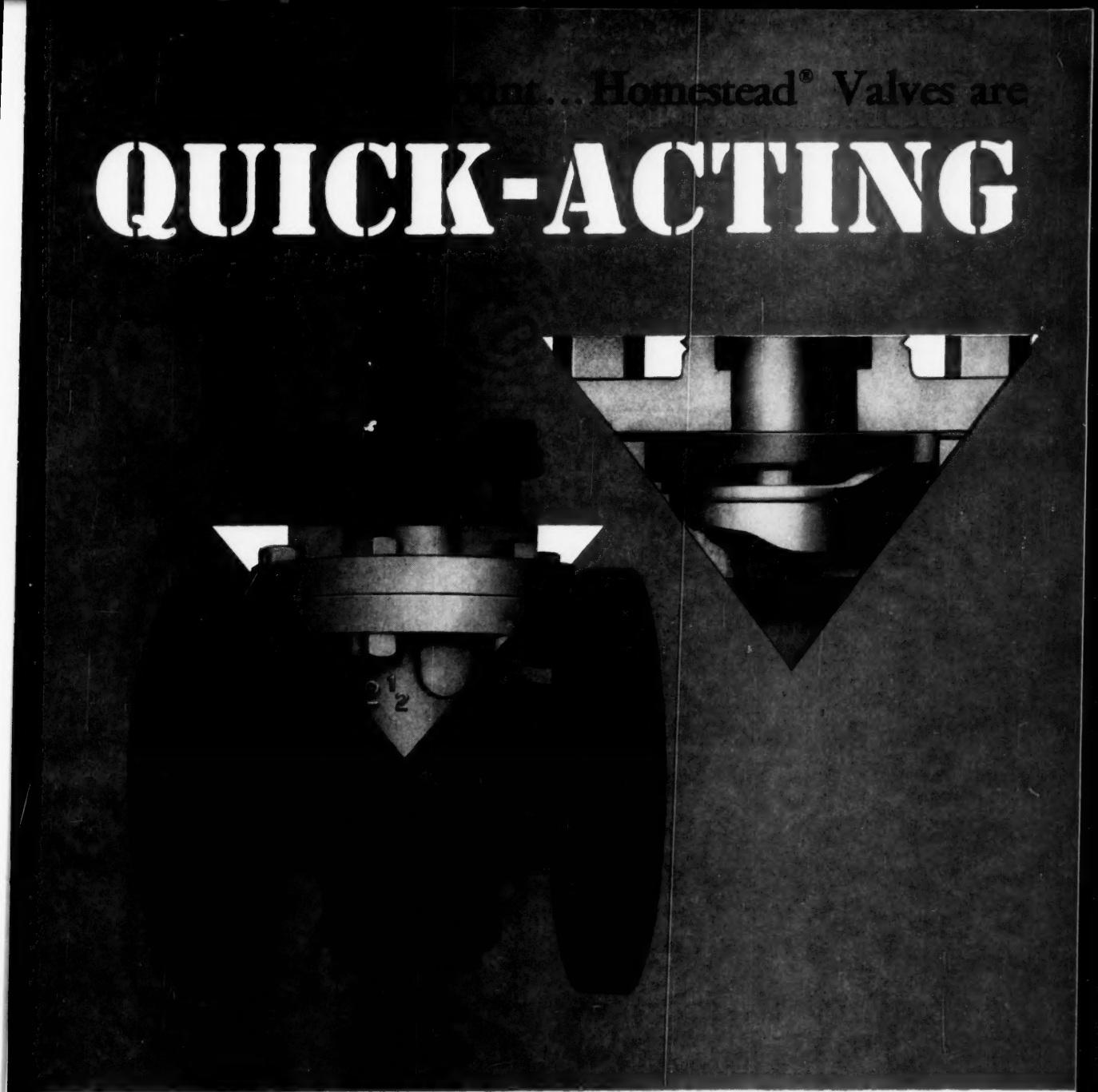
about any item in this department, circle its code number on the

Reader Service

postcard (p. 219)

...nt... Homestead® Valves are

QUICK-ACTING



FASTER FLUID CONTROL is guaranteed by the quarter-turn action that fully opens or closes Homestead Cam-Seald Valves. A cam limits plug travel and automatically presses the matched seating surfaces of the plug and body together to form a leakproof, metal-to-metal seal. Additional design features such as the sealed bottom, seal between cap and body, the deep stuffing box, and the fact that fluid or grit cannot pass across the seating surface in the open or closed position, assure long, leak-free service. Write today for complete information—see how Homestead fills your needs.

h
v

HOMESTEAD VALVE MANUFACTURING COMPANY

P. O. Box 13 • Coraopolis, Pa.

Chemical Firms Score in Sales, Find Profit Pickings Slimmer

	Sales (Thousand Dollars)		% Change		Profits (Thousand Dollars)	
	1956	1957	1957/1956		1956	1957
			Sales ▼	Profits ▼		
Allied Chemical & Dye	668,938	683,100	+ 2.1	− 7.7	47,000	43,400
American Cyanamid	500,651	532,479	+ 6.4	+20.1	44,247	51,347
Diamond Alkali	121,260	122,640	+ 1.1	−32.2	10,380	7,035
Dow Chemical[1]	333,128	337,203	+ 1.2	+14.2	25,444	29,957
Du Pont	1,917,353	2,000,000*	+ 4.3	+ 3.4	383,401	396,610
Food Machinery & Chemical	293,774	310,000	+ 6.0	+ 0.1	15,875	15,895
Grace	335,996	350,000*	+ 4.2		19,785	
Hercules Powder	244,361	254,714	+ 4.2	+ 2.2	17,703	18,116
Hooker Electrochemical	109,979	107,867	− 2.0	−23.0	11,496	8,848
Koppers	307,700	327,000	+ 7.0	−22.0	12,096	9,448
Monsanto Chemical	541,883	567,116	+ 4.7	− 3.1	38,646	37,416
Olin Mathieson	596,673	592,877	− 1.0	−18.8	44,791	36,377
Spencer Chemical	46,835	50,757	+ 8.4	−11.4	5,846	5,180
Stauffer Chemical	159,090	156,966	− 1.4	− 5.0	13,745	13,101
Union Carbide	1,324,506	1,395,032	+ 5.4	− 8.6	146,233	133,740
American Marietta[2]	202,310	234,038	+15.7	+ 6.4	16,204	17,182
Crown Zellerbach	462,350	460,609	− 0.4	−24.0	50,048	38,051
Devoe & Raynolds[2]	56,364	56,665	+ 0.6	−11.7	2,188	2,027
Goodyear Tire & Rubber	1,358,763	1,421,850	+ 4.6	+ 3.8	62,456	64,825
Marquette Cement	43,815	48,025	+ 9.6	− 1.0	7,376	7,306
Norwich Pharmacal	29,506	33,477	+13.5	+17.0	3,373	3,942
Owens-Illinois Glass	495,974	510,486	+ 2.9	+ 3.3	35,349	35,810
Parke, Davis	134,092	162,287	+21.0	+54.1	17,645	27,929
Phillips Petroleum	1,033,390	1,135,000	+10.0	+ 1.1	95,202	96,200
Rayonier	137,873	117,500	−15.0	−55.3	13,969	6,250
St. Regis Paper	369,000	360,000	− 2.4	−17.2	25,350	21,000
Shell Oil	1,644,417	1,773,359	+ 7.8	− 0.6	135,848	135,000
Smith, Kline & French	104,608	115,499	+10.4	+10.4	18,059	20,588
Sun Oil	200,457	186,905	− 7.0	−15.4	56,160	47,492
U. S. Rubber	901,260	873,583	− 3.1	− 1.1	31,870	29,695

* Estimated; [1] 6 mo. ending Nov. 30; [2] For fiscal year ended Nov. 30.

Chemical Profits: Harder to Keep a Buck

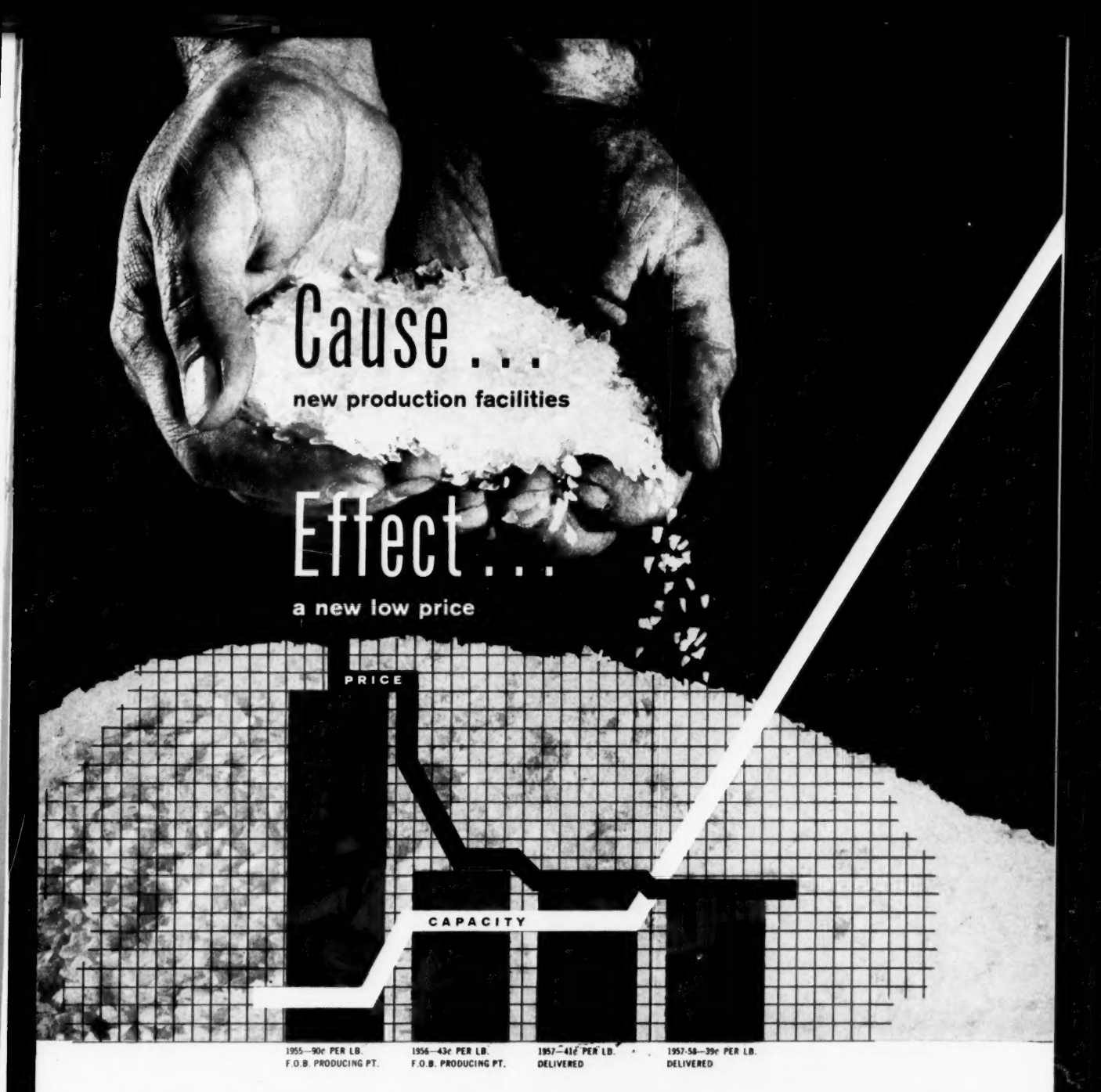
Sold more, made less—the chemical processing industries' fiscal paradox for 1957. Outlook for this year: More of the same.

William H. Chartener, McGraw-Hill Dept. of Economics

Despite sagging sales in the final quarter, chemical process companies still managed, as a group, to chalk up new sales records last year. But the late-year slump hurt profits so much that 1957 was for all but a few firms a year of narrowing profit margins.

Factors tending to dampen CPI profit reports—and the 1958 outlook—are the slowdown in normal growth of markets and, at the same time, a flood of new producing capacity. By late 1957 virtually no commercial product of any chemical processing industry was in short supply. And more new capacity will come on stream this year.

► **Profit Trimmers Ahead** — Prospects for improved profit



TRIMETHYLOLPROPANE . . . a fast 10,000,000 lbs. to feed growing industry

The properties of this free-flowing polyol are of prime importance to the fast-growing polyurethane foams industry. Trimethylolpropane's ability to improve both rigid and flexible foams, coupled with its easier processing, offer extremely valuable manufacturing advantages. And in the large alkyd resins industry serving the $1.6 billion paint market, this chemical intermediate is also finding important application.

But, until Celanese developed a method for high-volume, low-cost production, the usefulness of trimethylolpropane was severely limited. Today, a major Celanese production facility at Bishop, Texas, is geared to turn out in excess of 10 million pounds, providing industry with a high quality product at a practical price.

This is another example of how Celanese development and production anticipate and meet the needs of progressing industries.

Celanese®

Basic reasons . . . . . for improved products

Acids	Functional Fluids	Polyols
Alcohols	Gasoline Additives	Plasticizers
Aldehydes	Glycols	Salts
Anhydrides	Ketones	Solvents
Esters	Oxides	Vinyl Monomers

Celanese CHEMICALS

Agricultural	Paper
Automotive	Pharmaceutical
Aviation	Plastics
Building	Surface Coatings
Electrical	Textiles

CELANESE CORPORATION OF AMERICA, CHEMICAL DIVISION, DEPT. 553-D, 180 MADISON AVE., NEW YORK 16.
EXPORT SALES: AMCEL CO., INC., AND PAN AMCEL CO., INC., 180 MADISON AVE., NEW YORK 16.

Two-Way Profit Licking . . . Total Dollars . . . Ratio to Sales

Process Industry	% Change 1957/1956	% of Sales 1956	% of Sales 1957
Chemical & Allied Products	0	8.0	7.8
Industrial chemicals	0	9.9	9.6
Drugs & medicines	+25	10.0	10.8
Petroleum Refining	− 6	11.6	10.2
Paper & Allied Products	−20	6.1	5.0
Rubber Products	− 2	4.4	4.2
Stone, Clay & Glass Products	− 6	8.2	7.6

showings in 1958 are dimmed, furthermore, by low operating rates and stiff sales competition. McGraw-Hill's capital spending survey last fall reported chemical companies were operating at only 92% of capacity. They prefer to operate at 92%. Other process industries, too, were operating at less-than-preferred rates.

And operating rates have continued to drop since that Fall survey.

This means that new and more efficient equipment installed in recent years will not be running at profitable rates of capacity. Meantime, CPI companies must absorb higher labor and freight costs, and will need more costly sales efforts to maintain volume. Excess capacity also will mean continued heavy pressure on prices.

► **Sell More, Make Less** — Net sales of companies in the chemical process industries rose about 3% in 1957 over the 1956 total of $72.3 billion reported by the Federal Trade Commission and the Securities and Exchange Commission. Profits, however, dipped 6-7% below both pre-tax and post-tax levels for 1956 of $10.1 billion and $6.3 billion, respectively.

These CPI trends in sales and profits between 1956 and 1957 were just about the same as those for manufacturing industries in general—where sales were up about 3% and profits down about 5%.

Chemical and Allied Products —Net sales rose 4% from the 1956 total of $22.2 billion. But pre-tax profits were only about 1% better than the $3.3 billion in 1956. And profits after taxes in each year came to about the same—$1.8 billion.

Industrial Chemicals — (Now reported separately as well as in the chemicals and allied products total.) Sales were 4% over the $9.6 billion rung up in 1956; pre-tax profits rose slightly over the $1.7 billion reported the year before; and post-tax profits held steady at about $950 million.

Drugs and Medicines — (Another chemical sub-group now reported separately.) Companies in this class enjoyed big gains in both sales and earnings. Sales climbed more than 15% above the 1956 total of $2.7 billion. And profits before and after taxes jumped 25% from the 1956 figures of about $530 million (pre-tax) and $270 million (post-tax).

Petroleum Refining—Sales and earnings ran sharply ahead of previous rates in the early months of 1957 as the Suez crisis boosted export markets for domestic oil products. But demand slackened later in the year, leaving the industry with only a 6% gain in sales (from $24.9 billion in 1956) and an actual decline in earnings. Profits before taxes were down some 10% (from $3.6 billion); profits after taxes were off 6% (from $2.9 billion in 1956).

Paper and Allied Products—After many months of near-capacity operation, paper production and sales leveled off in 1957. At the same time new capacity was being added. A small sales decline during the latter half of the year pulled the year's total down 2% from the 1956 figure of $10.7 billion. There were even more severe dips in pre-tax profits—down over 20% from $1.3 billion in 1956—and post-tax profits—off 20% from $657 million.

Rubber Products—Net sales of rubber companies rose 3% in 1957—up from $6.2 billion in 1956. Pre-tax earnings held steady at about $550 million. And profits after taxes were off 1-2% from the 1956 total of $276 million.

Stone, Clay and Glass Products — Sales and profits in the ceramic group were hit by a prolonged cement strike early in the year and by slackening demand toward the end. Sales were just about even with the $8.3 billion in 1956. Pre-tax and post-tax profits slumped about 6% from $1.3 billion and $681 million, respectively.

► **Inventories Deter** — Corporation balance sheets show one important reason for fourth-quarter production cutbacks that prevailed through most of the CPI: Inventories were piling up.

Inventory totals at the end of the third quarter of 1957 (latest data available) compared with the same point in 1956 are as follows: For chemicals and allied products, inventories were up 6%; for petroleum refining, up 14%; for paper and allied products, up 1%; for rubber products, up 5%; for stone, clay and glass products, up 8%.

Financial positions, however, generally continued to be strong. Net working capital (excess of current assets over current liabilities) rose through the year in the drugs and medicines, rubber, and stone, clay and glass industries.

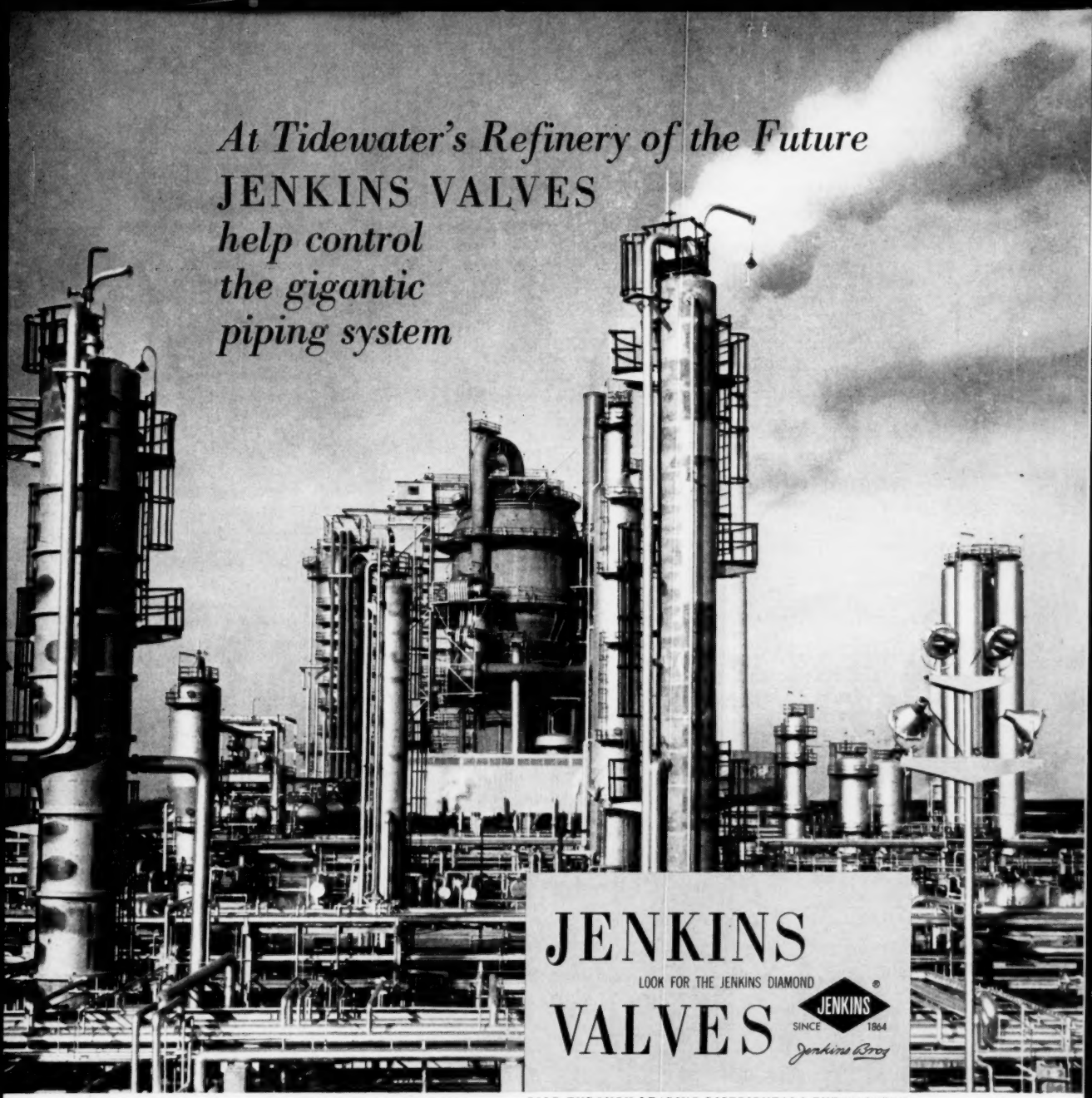
Industrial chemicals showed a small drop in net working capital (from $2,961 million to $2,810 million from the end of third-quarter 1956 to end of third-quarter 1957. Petroleum refiners reported an increase over the same period, although the third-quarter 1957 figure was off $230 million from the peak first quarter.

► **Feast and Famine**—For individual companies, large and small, 1957 was a year of variations in sales and earnings. Sales showed relatively narrow changes, up or down. But the earnings figures range from big pluses—like Parke, Davis' 54% rise—to big minuses—like Rayonier's 55% drop.

At Tidewater's Refinery of the Future

JENKINS VALVES

help control the gigantic piping system



JENKINS

LOOK FOR THE JENKINS DIAMOND

VALVES

JENKINS ® SINCE 1864 *Jenkins Bros*

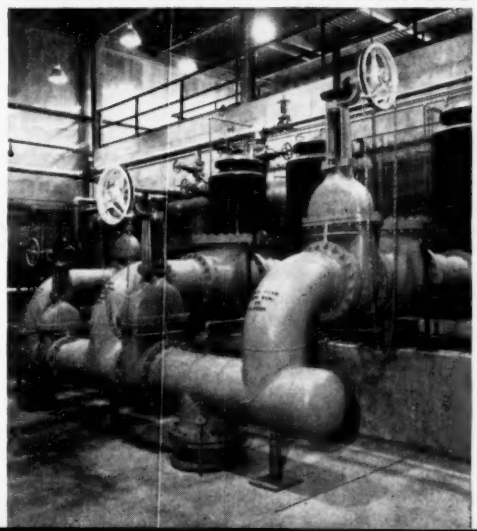
Primary Contractor: C. F. Braun & Co., Alhambra, Cal.

SOLD THROUGH LEADING DISTRIBUTORS EVERYWHERE

For the new Delaware Refinery of Tidewater Oil Company, careful selection of valves was unusually important. Tens of thousands of valves were required to control the maze of piping at this largest refinery ever built at one time.

To the valve specifiers for this gigantic piping project, the long record of Jenkins Valves for an extra-measure of efficient, economical service was good reason for using many thousands of Jenkins Valves in the total valve equipment of the refinery.

It will pay you to have the same important assurance when you specify or install valves . . . especially since Jenkins Valves cost no more. Jenkins Bros., 100 Park Avenue, New York 17.



These large valves made of Ni-Resist metal are among the thousands of Jenkins Valves in this great refinery. Sizes range from ¼" to 24"; made of various metals to suit different services.

Major chemical companies also scored wide differences. Allied reported a drop of almost 8% in profits, after a 10% drop the year before. Cyanamid, which reported a small increase in 1956, earned 20% more in 1957. Du Pont reversed its 10% drop of a year ago and boosted earnings about 3%. Olin Mathieson and Union Carbide, which had held even in 1956, saw earnings fall in 1957. Monsanto's earnings dropped only 3% last year, against a 12% dip in 1956 net earnings.

Nuclear Industry—1958-1968

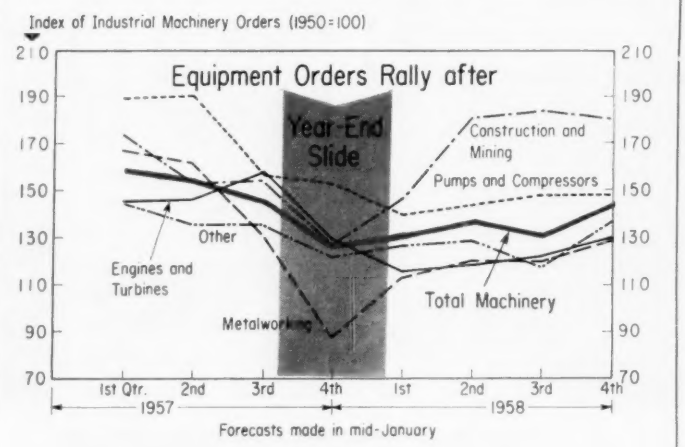
A ten-year look ahead for nuclear equipment sales both here and abroad, power potential and capital costs.

Putting its crystal ball to work again, the Atomic Industrial Forum has come up with its second growth outlook for the atomic industry—this time for the period 1958-1968.* In the words of Forum President Alfred Iddles, this report will help "strike a realistic balance between the over-optimism which still prevails in some quarters of the industry and the pessimism which has recently started to dominate others."

*"A Growth Survey of Atomic Industry, 1958-1968."

Some of the Forum's predictions:

- U. S. equipment manufacturers can look forward to $4 billion in sales of reactor hardware for domestic and foreign markets over the next ten years.
- Prospective sales for large domestic nuclear reactor systems will increase from $300 million/yr. in 1960 to from $350-660 million/yr. in 1968. (Naval, military and propulsion reactors alone comprise 40-80% of this total.)
- Prospective U. S. reactor sales to the six Euratom countries will range from $200-380 million ordered through 1965. (This estimate assumes that only about 40% (5.7 million kw.) of Euratom's 1967 goal of 15 million kw. of nuclear power capacity will be realized.)
- 1964 is the earliest possible date for the development and construction of a nuclear plant competitive with oil- or coal-fired electric generating plants. This progress would give the U. S. a total nuclear power reactor capacity of 6 million kw. by 1968.
- More pessimistic assumptions, however, pinpoint 1968 as the year of the first economic nuclear power plant. Total national capacity would be no more than 2 million kw. of nuclear power at that time.
- Nuclear reactor equipment costs will be shaved 15-35% (in terms of 1957 dollars) in the 1958-1968 period. (Cost estimates have increased sharply the past two years—as much as 115% between 1955 and 1957 quotations for such items as pumps, heat exchangers and specialized vessels.)
- Mean capital cost of large nuclear power plants due on-stream in 1960 will be about $430/kw., including indirect costs with interest during construction. For those plants starting up in 1968, estimates range from $280-360/kw.
- In the early 1960's, annual volume of business associated with small reactors (power prototypes, research and test reactors rated at less than 25,000 kw.) will temporarily equal, or even exceed, business generated by the nation's large nuclear power plants.



Ailing Equipment Sales Aim to Get Well in 1958

We're happy to pass along some good news about capital spending—a pivotal, and most disappointing, factor of our economy during the last half of 1957. McGraw-Hill's recent forecast of new orders for machinery suggests that the spending slide has already bottomed out (see chart above) and that equipment buying will step up during each succeeding quarter throughout 1958. So even though overall dollar volume of new orders for machinery this year will still fall short of last year by about 5%, things appear to be looking up again.

A clad "sandwich" being assembled prior to hot rolling. Claymont Stainless-Clad Plates—5 to 50% stainless inseparably bonded to carbon steel backing—offer the corrosion and abrasion protection of stainless steel plus the economy of carbon steel. This is another of the many steel plate products available from Claymont's integrated mill.

by d'Arazien

CLAYMONT
STAINLESS-CLAD PLATES

CF&I

CHECK CLAYMONT FOR—Alloy Steel Plates • Carbon Steel Plates • Stainless-Clad Steel Plates
High Strength Low Alloy Steel Plates • CF&I Lectro-Clad Nickel Plated Steel Plates • Pressed and Spun Steel Heads • Manhole Fittings and Covers • Fabricated Steel Products
Large Diameter Welded Steel Pipe

PRODUCTS OF WICKWIRE SPENCER STEEL DIVISION • THE COLORADO FUEL AND IRON CORPORATION
Plant at Claymont, Delaware • Sales Offices in all Key Cities

5788

HOW TO SELECT WATER-CONDITIONING EQUIPMENT (NO. 7 OF A SERIES)

*Water Impurities and Methods of Treatment**

HARDNESS *(Scale)* Calcium or magnesium salts such as bicarbonates, chlorides and sulfates	**Ion Exchange** (zeolite softeners). Generally used on clean, clear water to reduce hardness to a very low figure. Also avoids repumping. **Precipitator** (cold lime-soda softening). Used where turbidity, color or iron or manganese are also to be removed. Sometimes used for softening only—gives lower operating cost than ion exchange on high-carbonate-hardness waters. Reduces hardness to a few grains per gallon. Can be followed by zeolite softeners. **Hot-process Softener** (lime-and-soda process) usually followed by anthracite filter. Used for boiler feedwater. Also removes silica. Reduces hardness to a few grains per gallon. If followed by a zeolite softener (optional), no soda ash is used.
TURBIDITY Suspended dirt, sand, silt or other solids	**Sand Filter** (gravity or pressure type) alone . . . for water with moderately low turbidity content. **Precipitator** will reduce bulk of turbidity; generally followed by sand or anthracite filter for practically complete removal.
COLOR Dissolved or finely divided organic matter	A **Precipitator** with alum coagulant is generally used. Powdered activated carbon is sometimes added for further reduction of color. **Chlorination** may be used to kill living organic matter.
BAD TASTE OR ODOR Hydrogen sulfide (H_2S), cause of "rotten egg" odor	**Aeration** with several hours detention. **Adding chlorine:** Expensive except for removing small residuals. **Forced-draft degasifier:** Used if there are 10 or more ppm of H_2S or if CO_2 is also to be removed. **Carbon Purifier** (Carbo Dur®) or **Manganese Zeolite Filter:** For small volumes of water with 2 ppm or less H_2S.
Algae, organic matter	Same treatment as for COLOR. A **Carbon Purifier** may be used for small volumes of water . . . preceded by a sand filter if turbidity or debris is to be removed.
Excess chlorine	A **Carbon Purifier** provides simple, automatic operation. Also removes other causes of tastes and odors. **Sodium Sulfite** treatment reduces chlorine at lower equipment cost.
CORROSIVENESS Low pH due to free mineral acids	Neutralize with caustic soda, soda ash or lime.
Low pH due to carbon dioxide (CO_2)	**Aeration** reduces CO_2. A **forced-draft degasifier** removes practically all CO_2. **Neutralizing Amines** are used for corrosive hot condensate. Feeding **sodium silicate** will coat inside of pipes.
Alkalinity (carbonates and bicarbonates that form CO_2 under heat)	Can be reduced in a **Precipitator** with lime. Can also be removed by **Ion Exchange** (2 methods): Cation exchanger, sodium cycle, plus strongly basic anion exchanger, chloride cycle . . . for lower equipment cost on small flow rates, no handling of acids or alkalis, no blending of effluents. Cation exchanger, hydrogen cycle, then neutralization by blending with softened water or addition of caustic soda ("H and Na treatment") . . . for lower equipment cost on high flow rates and reduction of total solids.
IRON OR MANGANESE Ferrous or Manganous compounds (dissolved), bicarbonates, etc.	Up to 50 ppm of Fe can be removed with cation exchanger, sodium cycle—if water is clear and unaerated. **Aeration, raising** pH with lime, **settling** (in catch basin or Precipitator) and **filtering** will remove iron. If raw water pH is high enough to cause iron to precipitate on aerating, the lime or settling or both may be omitted. **Manganese Zeolite** ("oxidizing filter") for water with up to 2 ppm of iron or manganese.
Suspended iron (ferric hydroxide)	**Sand filter**—sometimes with a coagulant such as alum added just ahead of the filter.
SILICA *(Turbine blade scale)*	**Hot process softener** (and anthracite filter) for low and medium pressure boilers. **Ion exchange** (demineralizing) for more complete silica reduction for high pressure boilers.

***Factors in selecting specific treatments include:** initial or operating cost or space limitations, plans for future expansion, characteristics of raw water, desired effluent quality and volume . . . and degree of operating skill available (automatic vs. manual operation, facilities for routine chemical testing, etc.).

THE PERMUTIT COMPANY, Dept. CE-4, 50 West 44th St., New York 36, N. Y.

NEW VALVE-OLOGY

shuts off costly maintenance

Hancock 600# Steel Valves incorporate new concepts in valve-ology that reduce valve maintenance and equipment down-time. The forged steel bonnet and body have butting flanges so strong no distortion is possible. Compressed between them is a Flexitallic gasket so durable not even pressures exceeding ten times the rating of the valve can cause a blowout.

Hancock valve-ology makes full use of stainless steel to reduce your valving cost. Seat, disc, stem, swing bolts and nuts, thread bushing, packing gland follower—all are stainless steel. Globe, Angle, "Flocontrol", Lift Check, and Hi-Pressure Drop designs available. A high degree of standardization simplifies servicing and inventory needs. Your industrial supply distributor will gladly give you full details on Hancock Valve quality and performance. Phone him today.

Hancock 600# Steel Globe Valve. Type 5500 Line. Sizes: ¼" thru 2".

MANNING MAXWELL & MOORE INC. M&M TRADE MARK

H2-58

HANCOCK STEEL VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Watertown, Massachusetts
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

BRIDGEPORT BRASS

COPPER ALLOY BULLETIN

CONDENSER AND HEAT EXCHANGER TUBE EDITION

Advantages of Duplex Tube

by C. L. BULOW
Chief Corrosion Metallurgist
Bridgeport Brass Company

Bridgeport Duplex Tubes are used where a heat exchanger tube is attacked simultaneously inside and out by different types of corrosive media. Duplex is made by drawing two tubes of different metals, one over the other, and combining them into a single tube.

Metal Combinations

This type of construction permits the use of a wide range of combinations of metals—Admiralty, Cupro Nickel, Copper, Aluminum Brass, and many others coupled with steel, nickel, aluminum, stainless steel, Monel, etc.

Many Uses

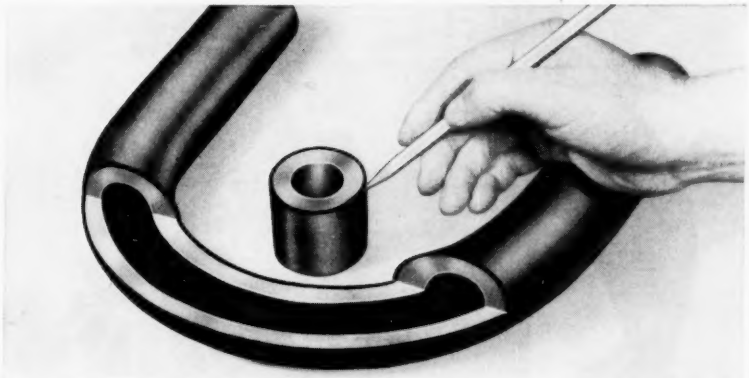
Applications for Bridgeport Duplex Tubes include successful service in the production of ammonia, benzol, hydrocarbons, resins, rubber chemicals, carbon dioxide and many other chemicals. Likewise, duplex tubes are admirably suited for replacement of ordinary boiler tubes for use in air-compressor aftercoolers, lube-oil coolers and fuel-oil heaters.

Applying Duplex Tubes

It is virtually impossible to prescribe what duplex tube combination is best for any specific use without information on the specific requirements of the application. The important point to remember is that with duplex tubes you can practically "tailor" the tube to your requirements.

Laminated Tube Sheets—Another Weapon In The Fight Against Dual Corrosion

Bridgeport now offers metallurgically bonded dual-metal tube sheets especially designed to combat dual corrosion. These tube sheets are a valuable adjunct to duplex and copper and copper-alloy condenser and heat exchanger tubes. They are available in a number of combinations such as Naval Brass, Muntz Metal, silicon bronze, copper, and Monel with steel and stainless steel.



Heavy-wall duplex consists of a thin wall of copper or other nonferrous metal around a thick-walled steel tube—a perfect combination for high pressures and utmost corrosion resistance.

New Bridgeport Heavy-Wall Duplex Tubes Lick Dual Corrosion Problems at High Pressures

High-pressure heat exchanger operation presents two very basic problems. The first is to find a tube thick enough to stand up under the pressures used. The second is to find a tube material able to withstand corrosive attack for long periods of time and at the same time provide desired heat-transfer characteristics.

New Heavy-Wall Duplex

Bridgeport came up with the answer in a new design—heavy-wall duplex tube. Heavy-wall duplex consists of a heavy inner tube with an outside covering of thin-wall nonferrous tubing. Although the inner tube is low carbon or stainless steel, and the outer tube Cupro Nickel, Red Brass, Admiralty or copper, both inner and outer tube materials can be varied to suit the conditions of the application.

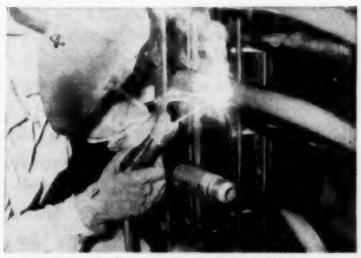
Advantages

Use of a nonferrous outer tube cuts corrosive effects of cooling water. And, because it resists corrosion, it gives the entire tube installation superior heat-transfer characteristics. With proper cleaning and maintenance, a Bridgeport Heavy-Wall Duplex Tube will substantially outperform single metal tubes.

Installation

Most applications are in cascade coolers where bent tube ends are required. Small sections of heavy-wall duplex can be formed to the desired radius or one end of long sections can be bent, thereby eliminating one weld joint.

Heavy-wall duplex tubes are designed to the ASME Code to operate at pressures up to 5,000 psi. They will, however, pass hydrostatic tests at much higher pressures. In actual operation they will give years of satisfactory trouble-free service with no more than normal cleaning and maintenance procedures.



To make hairpin turns, sections of heavy-wall duplex are bent and welded to straight lengths or other bent sections.

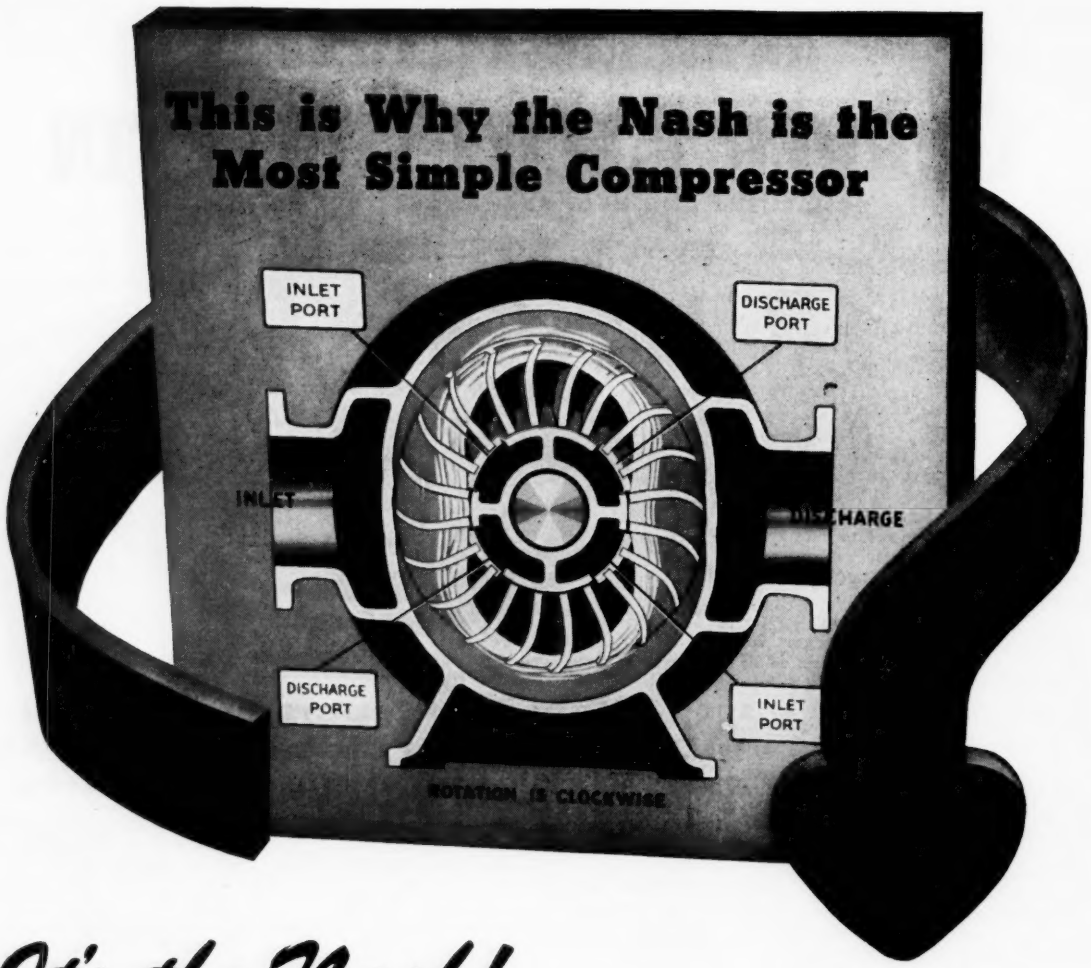
Further Information

More detailed information on sizes, characteristics and ratings of Bridgeport Heavy-Wall Duplex Tubes will be furnished on request. Our Technical Service representatives are also available to cooperate with you in working out application problems. For prompt service, call your nearest Bridgeport Sales Office.

Bridgeport

BRIDGEPORT BRASS

Bridgeport Brass Company, Bridgeport 2, Connecticut • Offices in Principal Cities
In Canada: Noranda Copper and Brass Limited, Montreal



It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

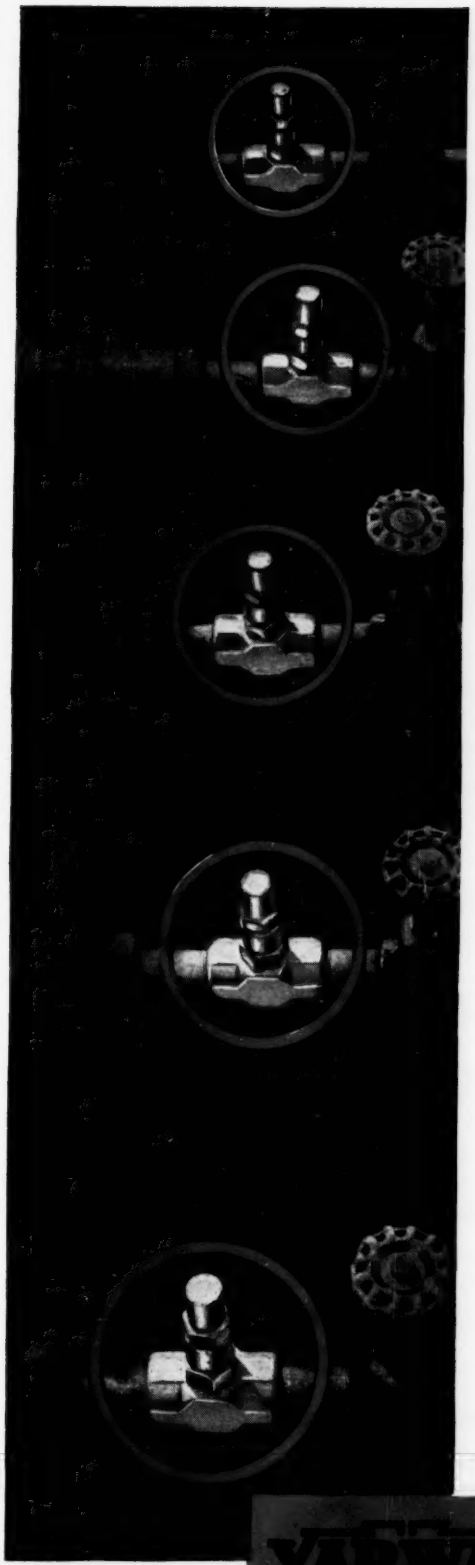
Saves floor space.

Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY
313 WILSON, SO. NORWALK, CONN.



two years on sulphur melters... *and no trap maintenance*

On any steam trap installation, one of the big questions to be answered is, "What maintenance is needed?"

Yarway Impulse Steam Traps answer the question in a convincing way in this tough outdoor installation on sulphur melting coils at a midwest chemical plant of International Minerals and Chemical Corporation.

"No maintenance in 2 years of hard service," the operators say.

Yarways have many features that contribute to such trouble-free records in plants coast-to-coast.

- **STAINLESS STEEL CONSTRUCTION.**
- **ONLY ONE MOVING PART . . . A SMALL VALVE.**
- **GOOD FOR ALL PRESSURES WITHOUT CHANGE OF VALVE OR SEAT.**
- **WON'T FREEZE UP.**

In addition to all that, *Yarways get equipment hot in a hurry and keep it hot.*

Buy Yarway Impulse Steam Traps from one of 270 local Industrial Distributors. For name of one nearest you, also free trap bulletin and Piping Diagram and Trap Selector for chemical processing equipment, write . . .

YARNALL-WARING COMPANY
137 Mermaid Avenue, Philadelphia 18, Penna.

THERE'S A YARWAY IMPULSE TRAP FOR EVERY NEED

SERIES 60 and 120

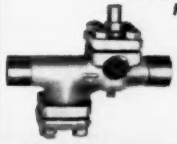
For all *normal* trap requirements, pressures to 400 and 600 psi.

½" No. 20-A

For *light loads* on tracer lines, steam mains, small presses, etc.

SERIES 40

For *heavy loads* requiring extra high capacity steam traps.



INTEGRAL-STRAINER HIGH PRESSURE TRAP

For *high pressures, high temperatures.* (Flanged or welding connections.)

YARWAY

IMPULSE STEAM TRAP

The Impulse that revolutionized steam trapping 20 years ago.

Do you have a DUST PROBLEM?

CALCIUM SULFATE
BAUXITE
T.N.T.
BARIUM SULFIDE
SULPHURIC ACID MIST
ALUMINUM OXIDE
LEAD OXIDE
PHOSPHATE DUST
PIGMENTS
PLASTICS
FERTILIZER DUST
ALUMINUM SILICATE
AMMONIUM SULFATE
INSECTICIDES
BARIUM CARBONATE
ALUMINUM POWDER
BARIUM SULFATE
LIME
CUPRIC OXIDE
SOAP DUST
CAUSTIC VAPORS

AAF TYPE N ROTO-CLONE DOES MANY JOBS FOR CHEMICAL PROCESSORS

If your operations require collection of heavy dust loadings of all particle sizes, you've got a job for the AAF Type N ROTO-CLONE. The engineered simplicity of this hydrostatic precipitator assures highest efficiency and lowest maintenance costs.

The rugged Type N achieves its high efficiency from the combined action of centrifugal force and thorough intermixing of water and dust-laden air. Compact design makes for important space savings.

For complete information on this versatile wet collector, call your local AAF representative or write direct for Bulletin 277.

AAF Dust Control Equipment

Illinois Heating Specialties

BETTER AIR IS OUR BUSINESS

Air Filters and Precipitators

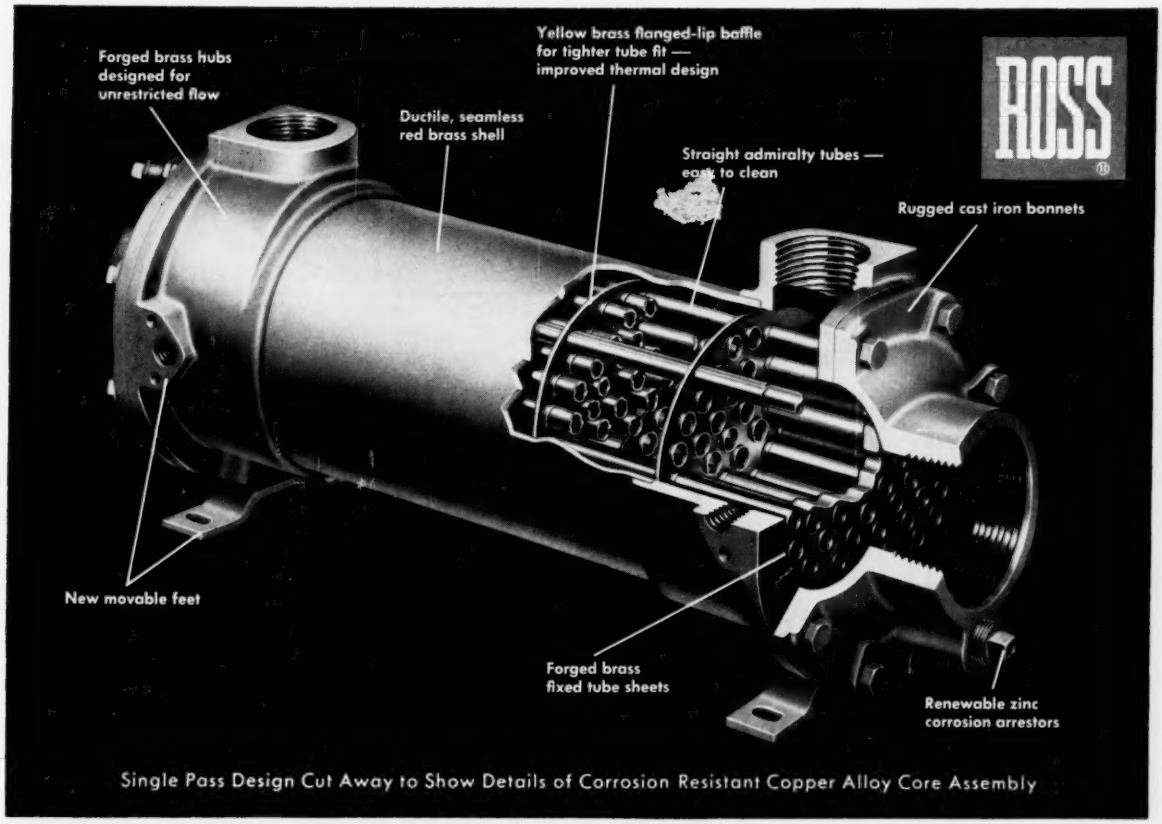
Heating and Ventilating Units

AAF American Air Filter COMPANY, INC.
herman nelson

326 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

LOOK AT THE LEADER'S LATEST . . .

'58 design of a famous line . . . Ross BCF Exchangers



Single Pass Design Cut Away to Show Details of Corrosion Resistant Copper Alloy Core Assembly

LOOK AT THE LIST . . . new design features, new sizes, new capacities, new mountings, new materials . . . *new low prices!* In 1958 the leader and originator of small, compact, fully standardized exchangers takes another step forward.

The Ross Heat Exchanger Division of American-Standard originated the whole BCF idea 14 years ago. Before then, pre-engineered design, mass produced parts and stocked assemblies were untried for a unit of this type. Designers and users of original equipment were quick to adopt the BCF as standard. Today, on a larger scale than ever, it is cooling lube oil, jacket water, hydraulic and other fluids for a wide variety of industries.

But, even with such success, the BCF has never been permitted to stand still. Ross has persisted in making constant design refinements and performance improvements . . . *1958 is typical: New* baffles with flanged lip at each tube hole and around outer edge for tighter fit and improved thermal characteristics. *New* stamped steel feet, movable in three positions around hubs for easy, more adaptable mounting. *New* sizes and capacities . . . 46 models . . . one, two or four pass designs . . giving greater selection than ever before.

Look at the leader's latest. Send in the coupon below for the new Ross Bulletin . . . an up-to-date run down on the 1958 Ross Type BCF Exchanger.

Mail this coupon for new Ross Bulletin

To: **American-Standard,** CE
Ross Heat Exchanger Division
Buffalo 5, N. Y.

Please send, without obligation, your new Bulletin 1.1K6 describing the 1958 Ross Type BCF Heat Exchanger.

NAME _____

TITLE _____

COMPANY _____

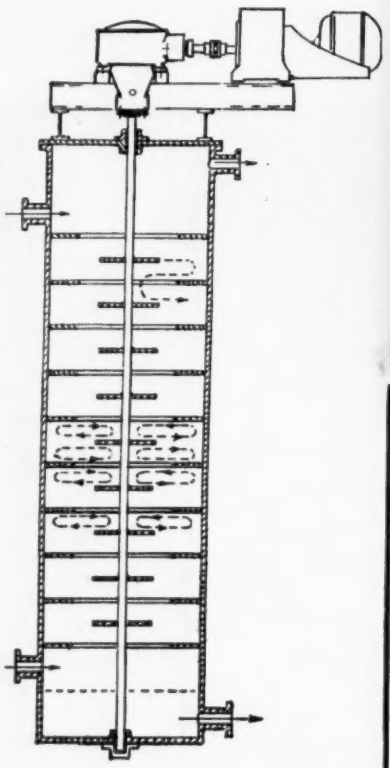
ADDRESS _____

CITY _____ ZONE _____ STATE _____

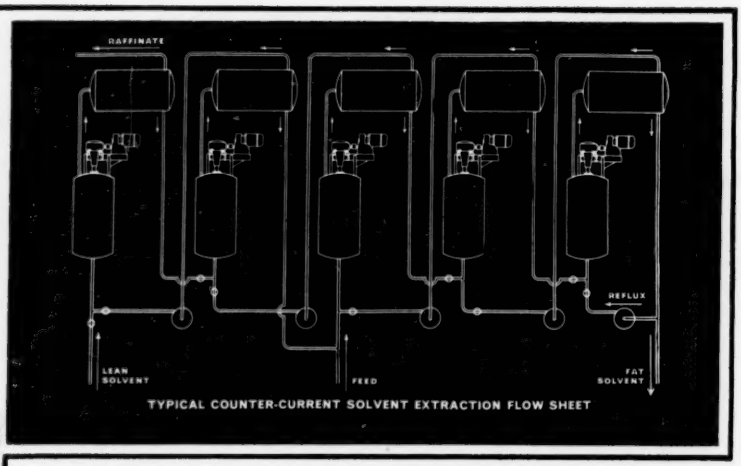
AMERICAN-Standard PRODUCTS

AMERICAN-Standard

ROSS HEAT EXCHANGER DIVISION



TURBO-MIXER R.D.C. COLUMN
Licensed Under
Shell Development Company Patent



TYPICAL COUNTER-CURRENT SOLVENT EXTRACTION FLOW SHEET

call on TURBO-MIXER for SOLVENT EXTRACTION

Whether you are extracting uranium with mixer settlers (like Kerr-McGee and Vitro) or butadiene (like Esso Standard or Polymer Corporation) or a continuous counter-current extraction column (like Bakelite), there's a Turbo-Mixer designed exactly to meet your needs.

Turbo-Mixers are designed for maximum service, based on over 40 years of experience and specialization in mixer construction. For descriptive information showing how your problems may be solved by Turbo-Mixer, write today.

FOR DETAILED INFORMATION AND USEFUL DESIGN DATA, SEND FOR THE FOLLOWING BULLETINS:

Please send me the following Turbo-Mixer Bulletin (s):

General Turbo-Mixer Bulletin_____

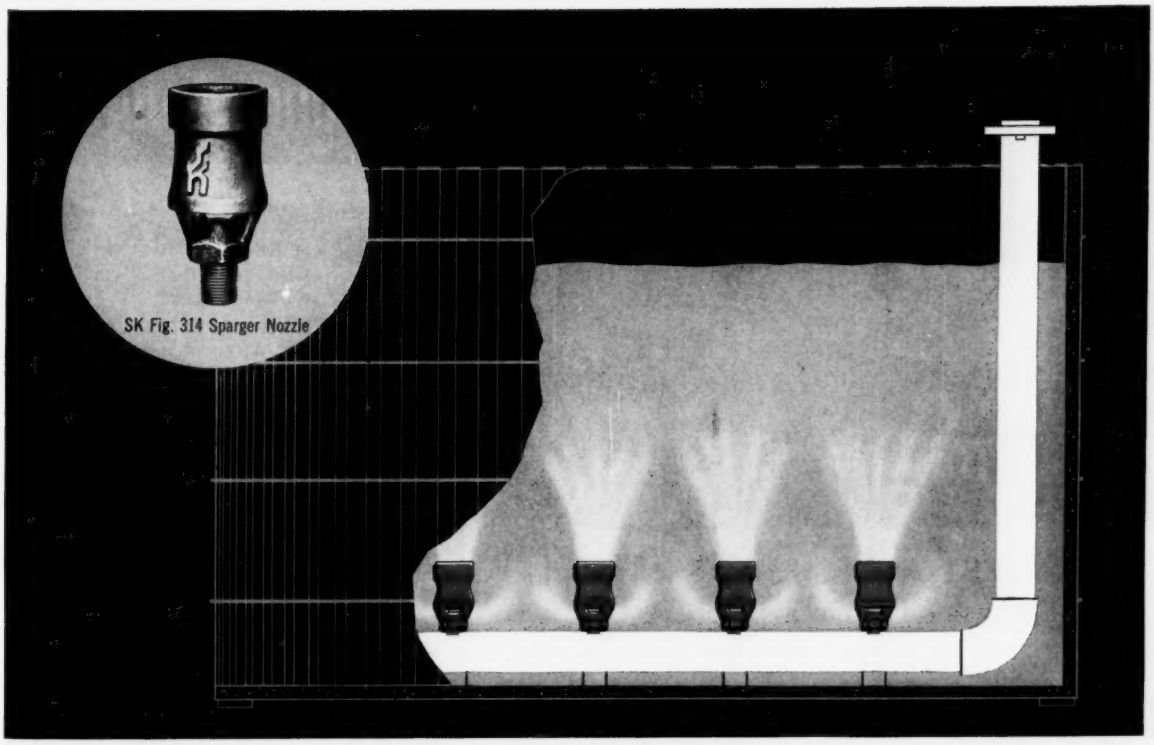
RDC Extraction Column Bulletin_____

Side Entering Propeller Mixer Bulletin_____

Absorption & Oxidation Bulletins_____

TURBO-MIXER DIVISION
GENERAL AMERICAN
TRANSPORTATION
CORPORATION

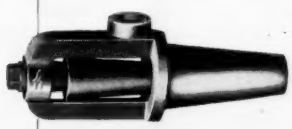
Sales offices: 380 Madison Avenue, New York 17, New York • General Offices: 135 South LaSalle Street, Chicago 90, Illinois • Offices in all principal cities



HOW TO HEAT AND AGITATE LIQUIDS IN TANKS

efficiently, economically, and with less noise

SK Fig. 301 Noiseless Heater for Tank Heating



SK Fig. 315 Circulating Heater for Tank Heating

SK Fig. 320 Continuous Heater for Pipe-Line Heating

SK Fig. 327 Slurry Heater for Pipe-Line Heating

Do it with plant steam and SK Steam Jet Heaters.

These Heaters utilize the jet principle to mix steam with a cold liquid, uniformly and without the noise and vibration usually associated with such operations. Since all of the heat in the steam is absorbed by the tank liquid being heated, operation is efficient. Because the jet action of the Heaters produces agitation and circulation, you need no additional equipment to perform these functions. Furthermore, since Steam Jet Heaters have no moving parts (except an adjusting spindle on some pipe-line types), you get long, trouble-free service without costly supervision and maintenance.

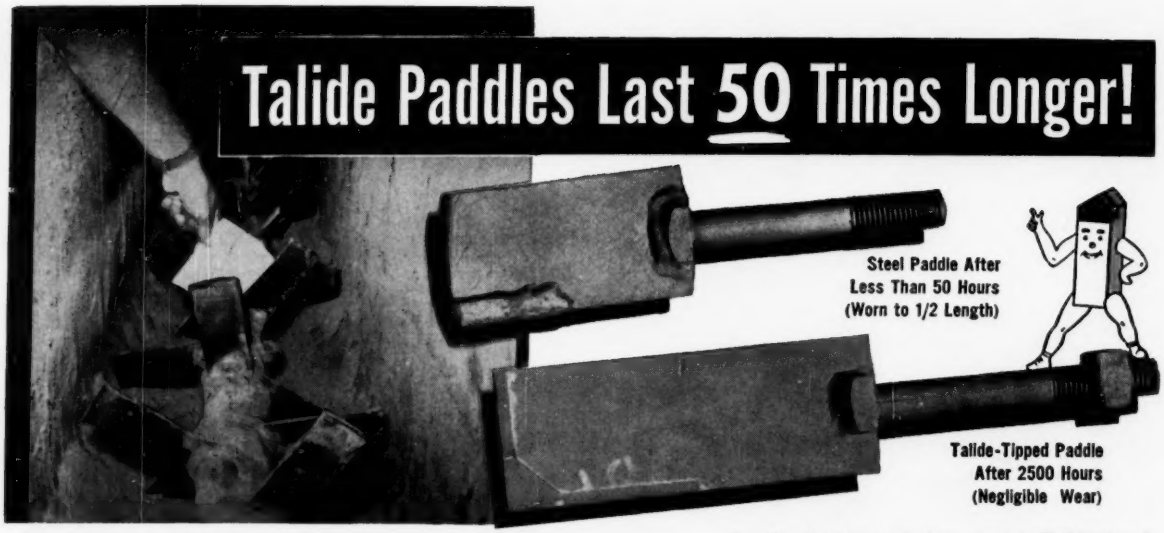
The illustration above shows tank heating being accomplished using SK Sparger Nozzles—one of the several types of Heaters offered by SK. Units of this type are ideal for use where uniform agitation is required over a large shallow tank area. In operation, a jet of steam issuing through the nozzle entrains tank liquid through the suction opening. Condensation takes place immediately upon mixing of liquid and steam and the stream of heated liquid is discharged at considerable velocity providing constant agitation.

Several other types of SK Steam Jet Heaters—for both tank and pipe-line heating—are shown at left. Complete details on all types are contained in Bulletin 3A which is available on request.

JET APPARATUS: Ask for Condensed Bulletin J-1.
ROTAMETERS & FLOW INDICATORS: Ask for Condensed Bulletin M-1.
VALVES: Ask for Condensed Bulletin V-1.
HEAT TRANSFER APPARATUS: Ask for Condensed Bulletin HT-1.
GEAR PUMPS: Ask for Bulletin 17-A.

Schutte and Koerting
COMPANY
MANUFACTURING ENGINEERS SINCE 1876
2217 State Road, Cornwells Heights, Bucks County, Pa.

Talide Paddles Last 50 Times Longer!



HARDEST MAN-MADE METAL!

TALIDE METAL, a tungsten carbide of superior quality, is harder, stronger, and more resistant to abrasion than any other metal. Properly applied, it gives superior service on applications where wear, heat, strain, and shock are destructive to other metals.

- **ABRASION RESISTANCE**— Up to 100 times that of steel.
- **COMPRESSIVE STRENGTH**— Higher than all melted, cast or forged metals and alloys.
- **RESISTANCE TO DEFORMATION**— 2 to 3 times greater than steel.
- **HEAT RESISTANCE**— Resists oxidation and thermal shock up to 1500° F.
- **THERMAL EXPANSION**— Less than half the rate of steel, "creep" is negligible.
- **FRICTIONAL RESISTANCE**— Lower than steel, non-galling, "slippery" properties higher.

ALL TALIDE METAL grades are made in latest type vacuum electric furnaces by precision methods under rigid control. A wide variety of shapes and sizes can be supplied—up to 25" in diameter, 100" in length, and 5000 pounds by weight. Parts can be supplied to any grit finish required down to one micro-inch. The physical properties of the most commonly used grades are listed below. Other grades are available for specialized applications.

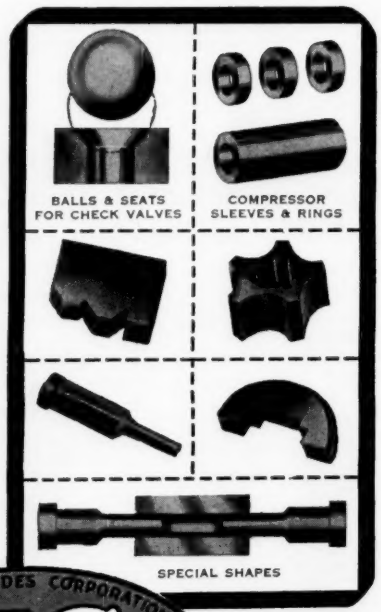
PHYSICAL PROPERTIES OF TALIDE METAL (P. S. I.)

Application	Operation	Talide Grade	Rockwell "A" Hardness	Specific Gravity (Density)	Transverse Rupture Strength	Compressive Strength	Co-Efficient of Thermal Expansion	Modulus of Elasticity (Deflection)
WEAR SURFACE	No Shock	C-91	91.8	14.90	235,000	710,000	3.00x10-6	91,000,000
	Light Shock	C-99	91.0	14.75	265,000	670,000	3.65x10-6	84,000,000
	Medium Shock	C-88	89.5	14.55	295,000	635,000	4.00x10-6	80,000,000
IMPACT	Light	C-85	88.4	14.25	315,000	600,000	3.75x10-6	77,000,000
	Medium	C-80	87.0	13.85	335,000	550,000	4.50x10-6	74,000,000
	Heavy	C-75	85.0	13.15	355,000	500,000	5.00x10-6	70,000,000

Note: Hardness values may vary plus or minus .2 to .3 on individual lots.

Leading brick manufacturer reports Talide-tipped pug mill paddles have outlasted 50 sets of hard-faced steel paddles to date—and are still in use. Operation involves mixing abrasive ceramic, clay and brick compositions.

TALIDE METAL is saving industry millions of dollars annually by wear-proofing vital parts on machine tools, presses, pumps, compressors and other types of processing equipment used in the steel, oil, chemical, plastic, auto, rubber, textile, glass, ceramic, mining and metalworking industry.

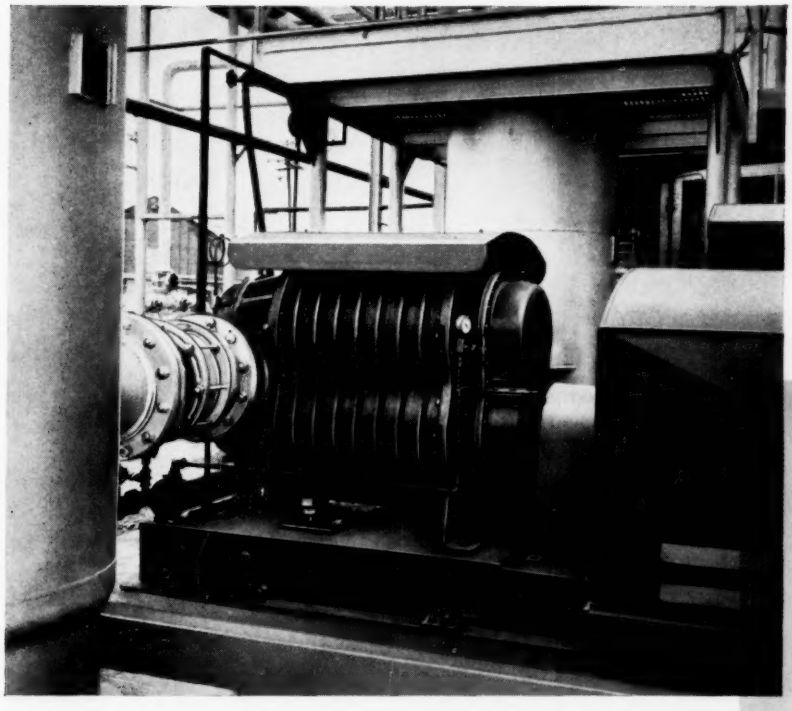


Send for new 76-page catalog 56-G or ask for sales engineer to call.

Metal Carbides Corporation
Youngstown 12, Ohio

AT KERR-McGEE OIL INDUSTRIES REFINERY

KERR-McGEE



14 x 27 Spiraxial Compressor delivers 3456 cfm at 28 psi discharge operating at 1800 RPM requiring 450 HP.

Sized for direct-connected drives with motors, engines or turbines, at speeds from 1,750 to 3,550 RPM.

•

Peak efficiencies at required discharge pressures.

•

Uncooled — requires no water jacketing.

•

No internal lubrication — delivers oil-free air.

•

Small space — low noise level.

•

Capacity ratings range from 700 cfm to 5,000 cfm, with pressures from 8 psi to 30 psi.

Rugged round-the-clock service without shutdown... thanks to R-C SPIRAXIAL® COMPRESSOR

The Cushing, Okla. Refinery of Kerr-McGee Oil Industries recently installed this 14 by 27 R-C Spiraxial Compressor and ran it for six months on a rugged 24 hour a day schedule—*without shut down or difficulties of any kind!*

The unit supplements the air supply to the regenerator and has helped increase throughput by 550 bbls. per day. Thus only a 1-year's run will pay for the installation!

Such sturdy, dollar-wise performance is typical of R-C Spiraxial units for refinery and many other types of service. Engineered with R-C patented Rotor Design, they insure greater efficiency, dependability and economy . . . require no water jacketing . . . reduce substantially both first cost *and* maintenance. Variable compression ratios widen the range of uses. Absence of internal lubrication assures oil-free air.

A product of progressive engineering, R-C Spiraxial Compressors are built to the same high standards of manufacture that have made Roots-Connersville the symbol of compressor dependability throughout the world.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.

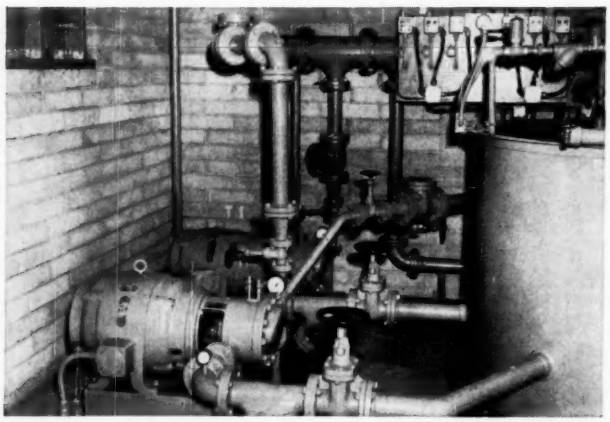
458 Illinois Ave., Connersville, Indiana. In Canada—629 Adelaide St., W., Toronto, Ont.

For additional data, please refer to our section in **Chemical Engineering Catalog** or **Mechanical Catalog** or write for Bulletin LAL-458.

A hippo surfaces with a cavernous yawn—powered by water from F-M pumps shown below.

From butterflies to hippopotami

F-M pumps make animals "live"



In one of the world's most fabulous amusement parks, waterfalls tumble; rivers flow; hippos yawn, and giant butterflies flap their wings—all water-powered by Fairbanks-Morse pumps with F-M motors.

Although a most unusual application, these F-M installations demonstrate the flexibility and experience of Fairbanks-Morse in working with the engineers of any organization.

Whatever type, size or capacity pumps you need—you're sure of satisfaction when you call in your F-M Sales Engineer. Contact him today, or write directly to Fairbanks, Morse & Co., 600 South Michigan Avenue, Chicago 5, Illinois, Dept. CE-4-7.

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • MAGNETOS

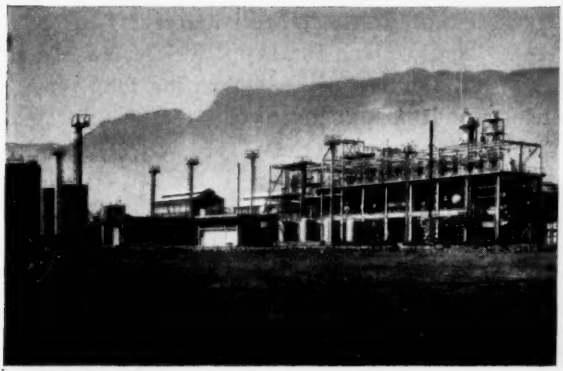
ONE OF A SERIES OF ADVERTISEMENTS ON LUMMUS' WORLD-WIDE FACILITIES

Headquarters of SFTL

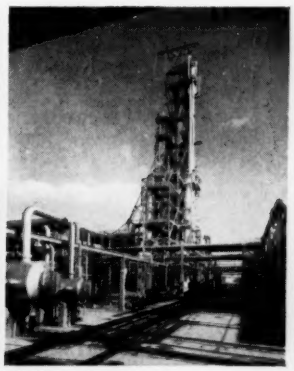
40,000 B/D Complete Refinery

In Paris we are Societé Francaise des Techniques Lummus

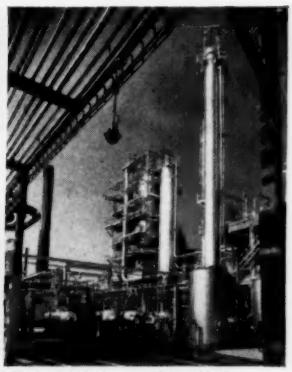
A staff of over 300 Specialists Serves Process Industries in Continental Europe while Joining Six Other Lummus Offices and Subsidiaries to Circle the Globe



Phenol-Acetone Plant



Ethylene Plant



Fluid Catalytic Cracking Unit

Founded in 1948 to serve Continental Europe, Societé Francaise des Techniques Lummus' specialized technical staff has designed, engineered and constructed scores of the more than 700 Lummus petroleum, chemical, and petrochemical projects throughout the world in the last half century.

SFTL's record includes projects with great variety of size and type. Among recent projects handled by SFTL are pictured above: a complete 40,000 B/D Refinery consisting of nine process units and all offsites, an Ethylene Plant, a Fluid Catalytic Cracking and Gas Recovery Unit and a Phenol-Acetone Plant.

SFTL is also ready to join forces with any one of six other Lummus offices and subsidiaries – located in New York, Houston, Montreal, Maracaibo, London, The Hague – to make Lummus facilities easily available around the world.

The flexibility of the Lummus organization permits advantageous arrangements for our clients in the acceptance of various currencies in payment for our services.

See Lummus on your next project.

* * * *

THE LUMMUS COMPANY, 385 Madison Avenue, New York 17, N. Y. Houston, Chicago, Washington, D.C., Montreal, London, Paris, The Hague, Caracas, Maracaibo. *Engineering Development Center*, Newark, N. J.

LUMMUS

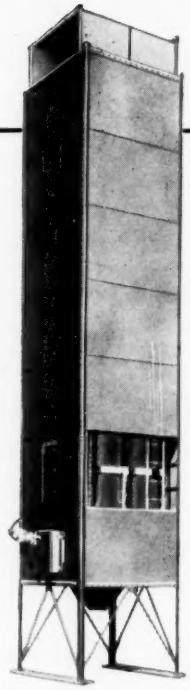
ENGINEERS AND CONSTRUCTORS FOR INDUSTRY

385 MADISON AVENUE, NEW YORK 17, N.Y.

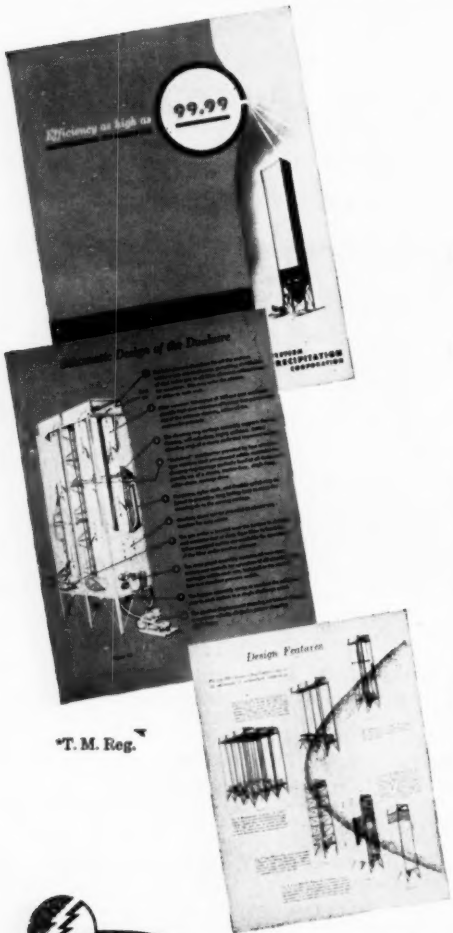
The latest advancement in dust recovery

Dualaire*

JET-CLEANED DUST COLLECTORS



- *Cleans without jarring or rapping!*
- *Maintains uniformly low pressure drop!*
- *Field-proven efficiency as high as 99.99%!*



*T. M. Reg.

Backed by the same organization that pioneered commercial application of COTTRELL Precipitators and MULTICLONE Collectors, the DUALAIRE Jet-Cleaned Dust Collector is revolutionizing filter-type recovery systems. The DUALAIRE gives you vital advantages like these...

JET-CLEANING ACTION clears the filter tube continuously in small increments—not with sudden surges as in rapping or jarring.

CLEANING ACTION starts automatically and stops automatically to keep pressure differential within low pre-set range.

FILTER EFFICIENCIES under actual field operations, run as high as 99.99%. And filter capacity remains uniformly high at all times because no thick filter cake ever forms to reduce effectiveness!

NO STANDBY UNITS, with their complicated switching devices, are needed. The DUALAIRE is cleaned as it filters — without interruptions or shut down periods for cleaning. The operation is continuous!

FILTER UNITS LAST LONGER because they are not subjected to intermittent jarring, rapping or vibration—all destructive to filter fabrics.

The above are only a few of the many important advantages you get in DUALAIRE Dust Collectors. This 8 page booklet gives the full story... explains how the jet-cleaning action works—shows how the basic DUALAIRE unit is adaptable to a wide range of operating requirements—provides facts, figures and illustrations that will change your thinking on filter-type recovery systems. Send for your free copy of this descriptive booklet—or see your nearest Western Precipitation representative.

COTTRELL Electrical Precipitators
MULTICLONE Mechanical Collectors
CMP Combination Units
DUALAIRE Jet-Cleaned Filters
HOLO-FLITE Processors
HI-TURBIANT Heaters

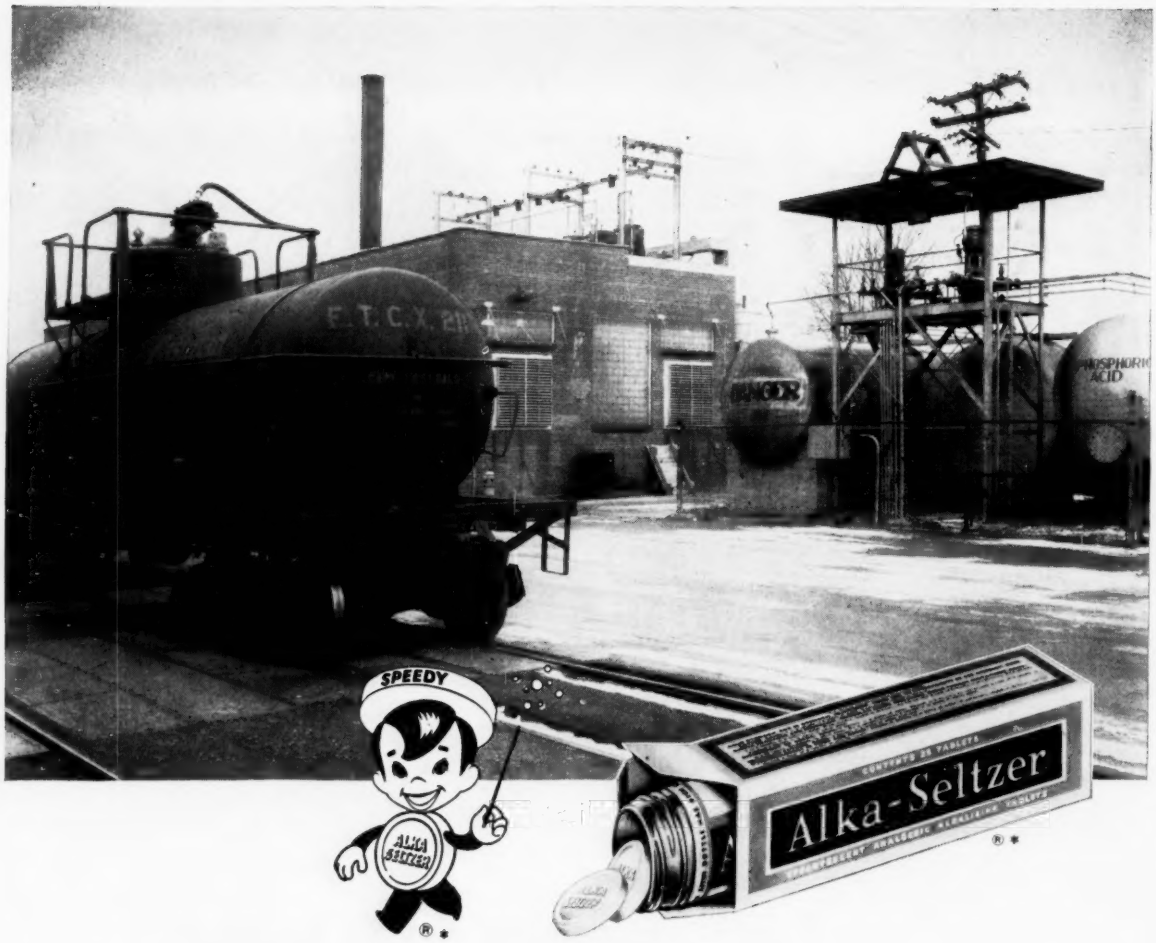
WESTERN
PRECIPITATION
CORPORATION

Engineers and Constructors of Equipment for Collection of Suspended Material from Gases . . . and Equipment for the Process Industries

LOS ANGELES 54 • NEW YORK 17 • CHICAGO 2 • PITTSBURGH 22 • ATLANTA 5 • SAN FRANCISCO 4

Representatives in all principal cities

Precipitation Company of Canada Ltd., Dominion Square Bldg., Montreal



NO HEADACHES HERE

Miles Laboratories, Inc. have relieved untold millions of headaches with their familiar Alka-Seltzer* tablets, but they have no headaches of their own in handling the considerable quantities of acetic anhydride and phosphoric acid required in their operations. This job is done by the two LaBour Type G pumps seen in the photograph.

These pumps unload tank cars as shown, or tank trucks on the paved area, and also move liquid to process from the storage tanks. They've delivered a combined total of 19 years of dependable service, without one minute of unscheduled time out. "They've never let us down," say the Miles people.

In the picture, note that the car is being unloaded through pipes under the pavement. During operation these are under less than atmospheric pressure, so there can be no loss of liquid. The packingless Type G's can't leak, either, and their only maintenance requirement is routine lubrication.

If you want dependable pump service without headaches, take a tip from the headache experts and specify LaBour.

*Alka-Seltzer and the "Speedy" figure are registered trademarks of Miles Laboratories, Inc., Elkhart, Ind.

ORIGINAL MANUFACTURERS OF THE SELF PRIMING CENTRIFUGAL PUMP

LABOUR

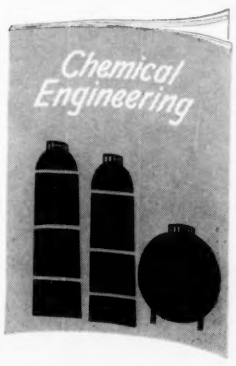
THE LaBOUR COMPANY, INC. • ELKHART, INDIANA, U. S. A.

PHOTO COURTESY CORNING GLASS WORKS

20,000,000 passengers safe in the hands of the Chemical Engineer

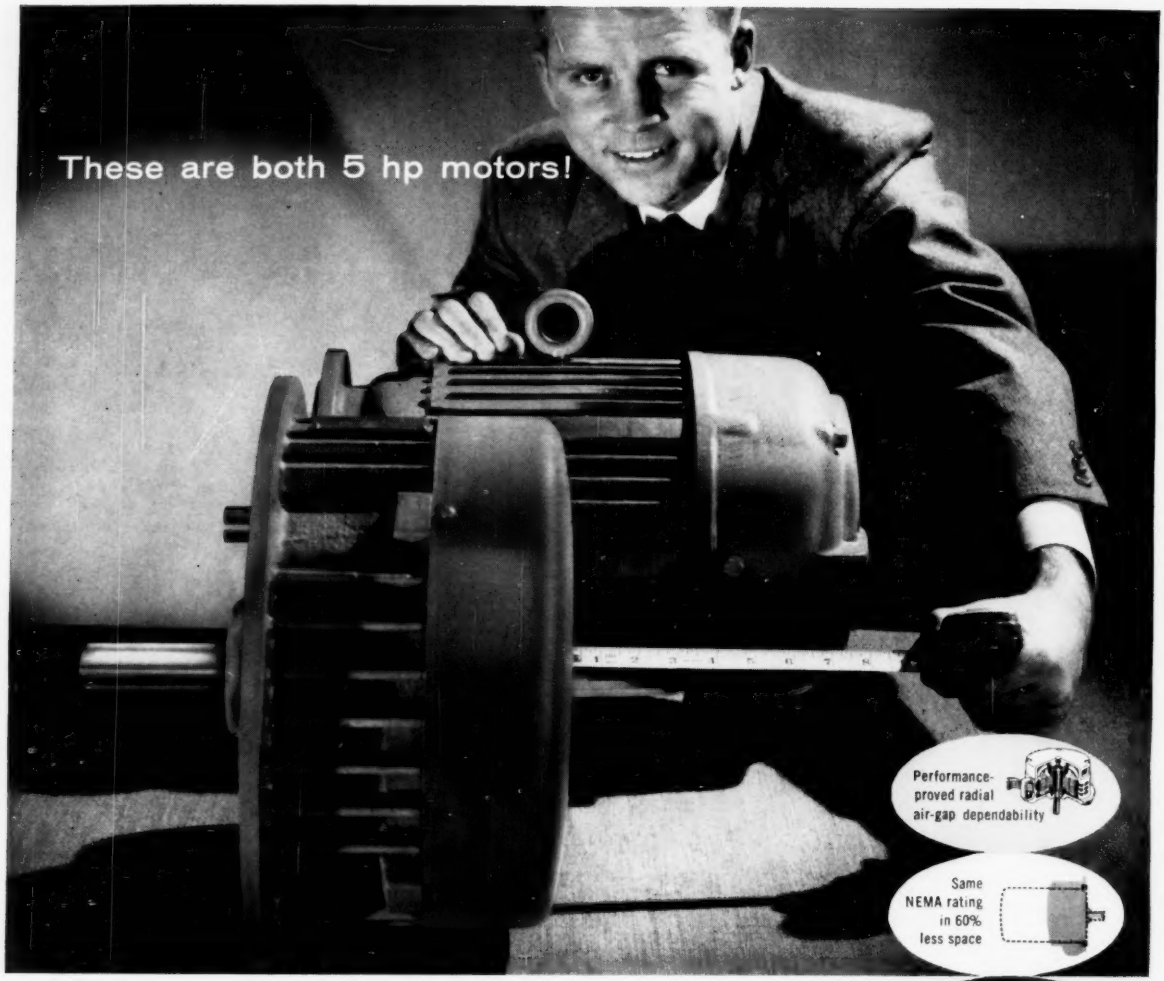
Special glass lenses for runway lights . . . another service to mankind made possible by the Chemical Engineer and his technology

Wherever chemical processes are used in industry . . . in the familiar chemical process industries and constantly stretching beyond . . . the chemical engineer is your first sales target. He's the instigator behind that new product, that new process, that new plant. His influence is evident in every order for new equipment, raw materials and supplies. Sell him first, and you've sold the CPI.



Whatever his function — from pilot plant to front office — you can get him on your side if you talk to him in the one publication that talks his language—*exclusively*—CHEMICAL ENGINEERING — preferred by a margin of 3 to 1 among chemical engineers in all functions, in all industries. This year it will reach them with a greater timeliness and impact than ever before. CHEMICAL ENGINEERING, A McGraw-Hill Publication, 330 W. 42nd St., New York 36, N. Y.

Published every other monday
for Chemical Engineers in all functions



60% shorter– but with radial air-gap design!

New Louis Allis Pancake Motor preserves all the advantages of conventional motor construction

The new Louis Allis Pancake Motor is your solution to trouble-free power in any space-cramped motor application.

The Pancake is a remarkably short flange-mounted motor — up to 60% shorter and 33% lighter than standard motors of the same rating! And it is built in *conventional* radial air-gap design!

It's done by an ingenious forming process which literally compresses the end coils of a conventional radial air-gap motor into an exceptionally short length. The result is a compact, light motor ideally suited for horizontal or vertical mounting on machine tools, roof ventilating fans, or *any* close-quarter installation where space is a critical design factor.

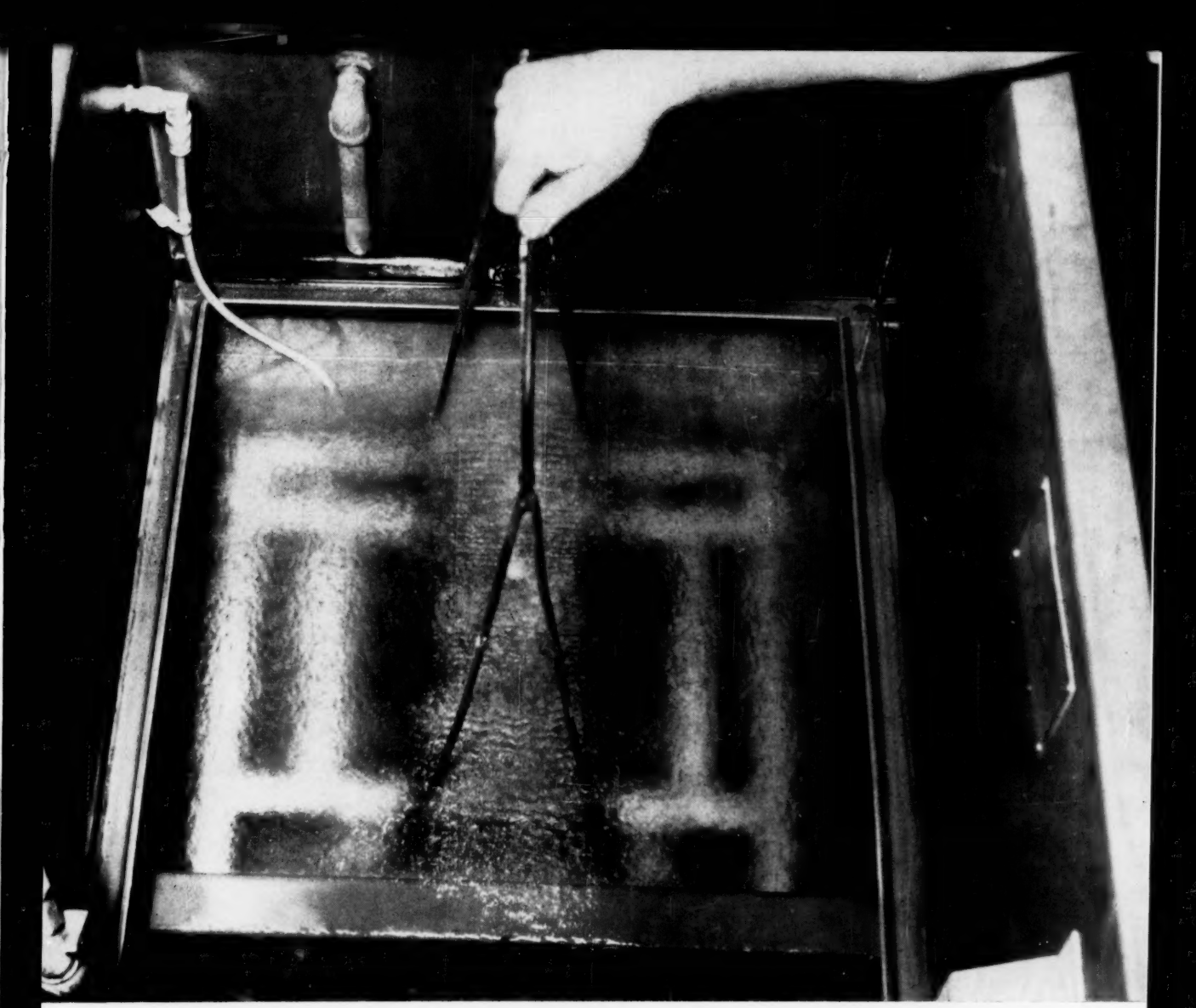
What's more, this is achieved without sacrificing a single desirable characteristic: the stator still contains the same iron and copper as standard Louis Allis motors . . . standard NEMA service factor is maintained . . . high insulative values are retained by using proved Louis Allis varnishes and new insulating techniques . . . over-sized pre-lubricated bearings are used to guarantee long bearing life . . . and the entire motor is enclosed in an industrial-type cast-iron housing designed to shrug off abuse!

The housing and flange are cast in one piece: this permits extra-accurate internal machining which extends bearing life and reduces noise levels to a new low.

Investigate the Pancake Motor through your local Louis Allis District Office. Sized from 1 to 15 hp, at 1800, 1200, and 900 rpm, in open drip-proof and enclosed non-ventilated or fan-cooled enclosures. Write for Bulletins 2100 and 2150 to the Louis Allis Co., 447 E. Stewart St., Milwaukee 1, Wis.

LOUIS ALLIS

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES



This unit cleans machine parts with solvents and ultrasonic waves. The walls are made from Stainless Steel because Stainless resists corrosion and will not contaminate the parts being cleaned.

Only Stainless Steel can stand high-frequency vibrations in cleaning units

The Detrex Chemical Industries, Inc. of Detroit has developed a method of cleaning machine parts with 10-second exposures to ultrasonic waves in vats of trichlorethylene.

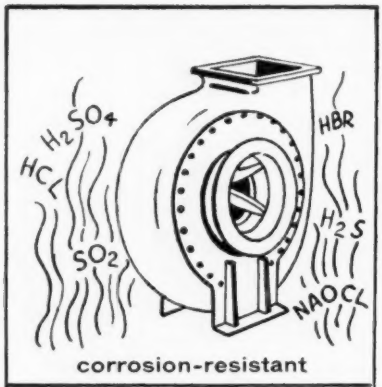
Stainless Steel is the only metal that can be used in these vats. They tried others but found that in time the ultrasonic waves shook loose tiny specks of corroded metal from the vat walls and dropped them on the cleaned machine part.

With Stainless Steel vats there are no tiny specks of corrosion. The Stainless takes these high-frequency vibrations every day and it doesn't even show a pin-point spot in its hard, smooth finish.

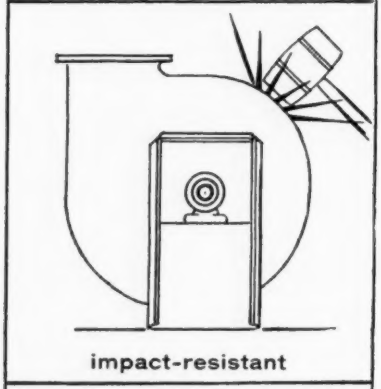
When you buy new equipment for your plant, think about corrosion-resistant Stainless Steel. If you want service-tested quality, specify USS Stainless Steel. *USS is a registered trademark*

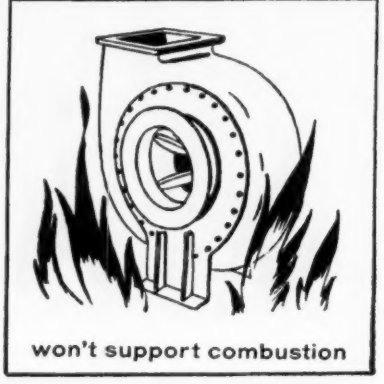
United States Steel Corporation–Pittsburgh
American Steel & Wire–Cleveland
National Tube–Pittsburgh
Columbia-Geneva Steel–San Francisco
Tennessee Coal & Iron–Fairfield, Alabama
United States Steel Supply–Warehouse Distributors
United States Steel Export Company

USS **United States Steel**



corrosion-resistant


impact-resistant


won't support combustion

"BUFFALO" RESIN-BONDED FIBER GLASS FUME FANS

These new fans further broaden the selection of "Buffalo" exhausters for the chemical industries, and offer advantages of versatility, lighter weight, reasonable cost and reliability.

The new Type "FG" offers excellent chemical resistance to a wide variety of acids, salts, gases, organic materials and other corrosives. It is suitable for temperature applications up to 225°F.

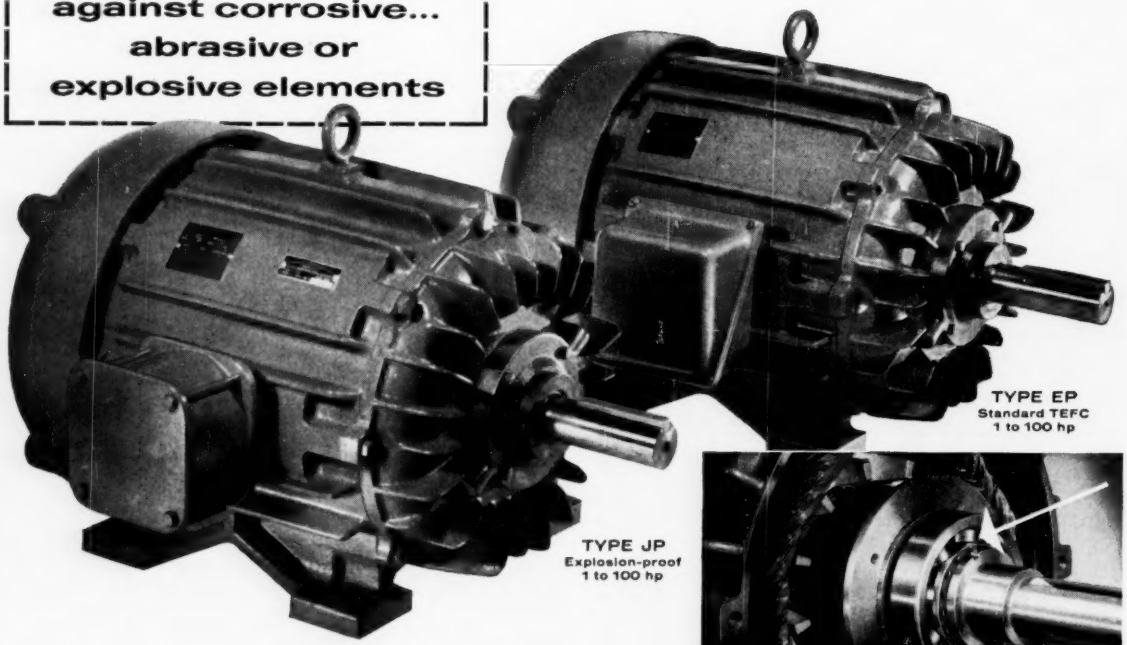
The fan housing is entirely of resin-bonded fiber glass, with stainless steel studs molded-in for attachment to the bearing stand. The rotor is a carefully balanced steel wheel with all exposed parts encased in thick fiber glass. In standard capacities up to 34,000 cfm at pressures to 10″ static. Write for Bulletin FI-511 for all details, including chemical resistance table and "Q" Factor* construction details.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

BUFFALO FORGE COMPANY
BUFFALO, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

YOU GET
EXTRA PROTECTION
against corrosive... abrasive or explosive elements



TYPE EP
Standard TEFC
1 to 100 hp

TYPE JP
Explosion-proof
1 to 100 hp

with

Wagner totally enclosed motors... protected for longer motor life

If you need motors that will keep production rates up . . . that will give the continuity of service that is so important to automation . . . that will operate with complete dependability under the most severe conditions—Wagner totally-enclosed motors are your soundest choice.

Type EP Motors offer protection against corrosion, dust, abrasives, fumes, steel chips or filings. Type JP is explosion proof as well—designed and approved for use in explosive atmospheres.

NEW NEMA FRAMES . . . These motors are built in the new NEMA Frame sizes from 182 through 445U, with ribs that add mechanical strength and increase the surface cooling area. Effective cooling system adds to motor life. Let your Wagner Sales Engineer show you how these protected motors can bring you savings on initial motor costs, maintenance costs and continuity of operation.

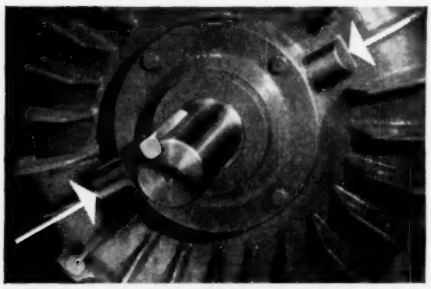
1 TO 100 HP—4 POLE, 60 CYCLE—
NEMA FRAMES 182 THROUGH 445U

Wagner Electric Corporation
6407 Plymouth Ave., St. Louis 14, Missouri.

WH58-5

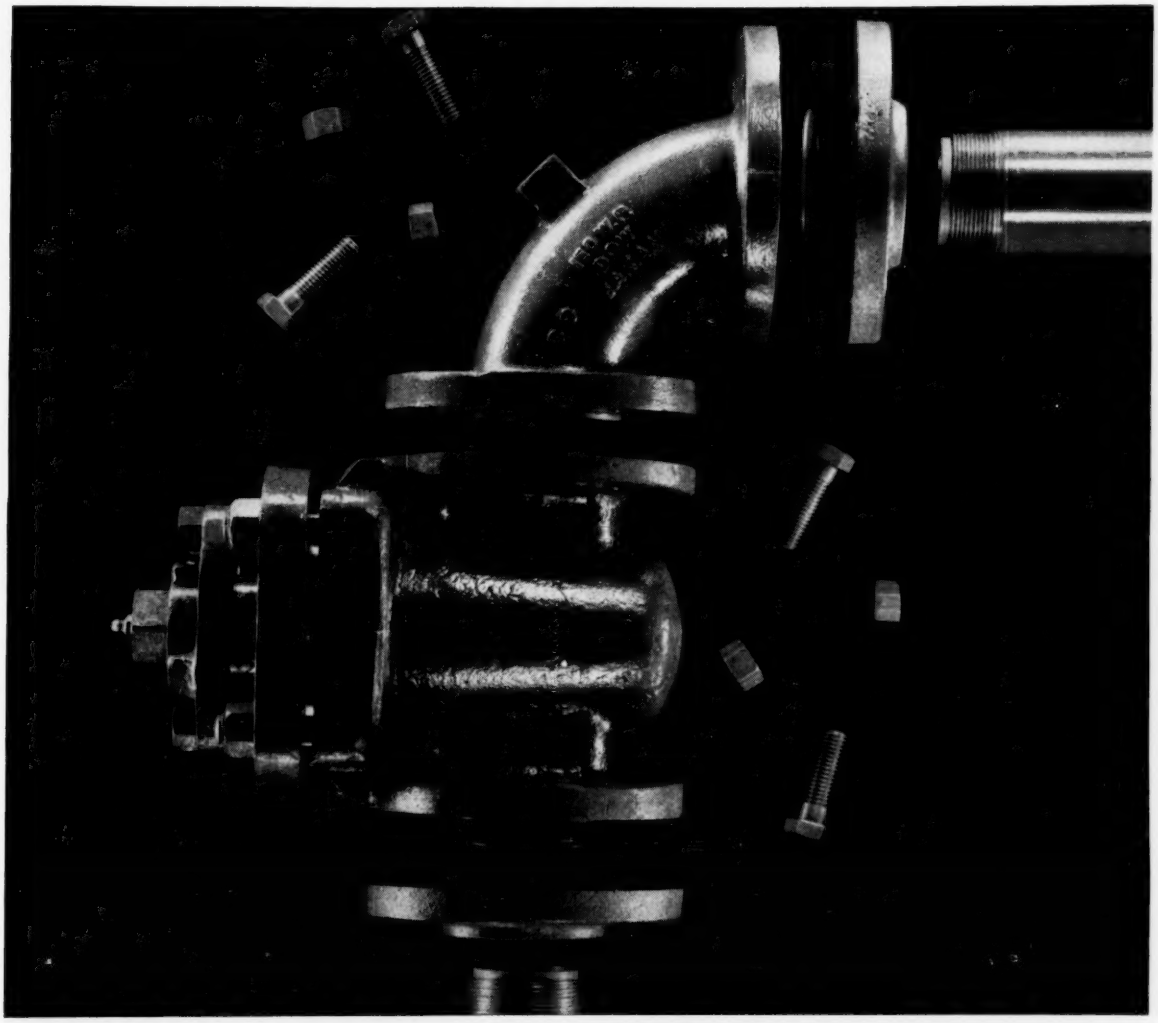
BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

HEAVY DUTY BALL BEARINGS . . . The ball bearings used in these motors are of the highest quality, with more than ample capacity to provide long troublefree service under heavy loads.



BEARINGS CAN BE RELUBRICATED . . . Factory installation will last for many years under normal service, but openings are provided to permit relubrication that adds years to motor life under severe conditions.

SEALS KEEP BEARINGS CLEAN . . . Both ends of these motors have running shaft seals to keep the bearings clean. Bearing housings are effectively sealed to prevent escape of grease.



You can see why Saran lined pipe cuts operating costs

These corrosion-resistant pipes, fittings and valves are stock items, and they can be fabricated in the field

The long range economy of Saran lined pipe starts right here—with the immediate availability of pipe, fittings and valves . . . as stock items. There's no waiting . . . no price premium to pay.

And Saran lined pipe can be fabricated in the field. Only conventional hand tools or power equipment are needed to cut and thread it right on the job site.

Saran lined pipe pays off through the years with superior corrosion resistance and strength. When you specify the new gray Saran lined pipe, valves, pumps and fittings, you'll be able to pipe commonly used acids, alkalies and other corrosive liquids under a wider temperature range.

You can plan a *complete* corrosion-free pipe system with Saran lined pipe, valves, pumps and fittings. They're available for systems operating from full vacuum up to 300 psi and temperatures from −20° F to 200° F. Send the coupon today for further information. And be sure to ask about Saraloy® 898 tank lining, too. THE DOW CHEMICAL COMPANY, Midland, Michigan.

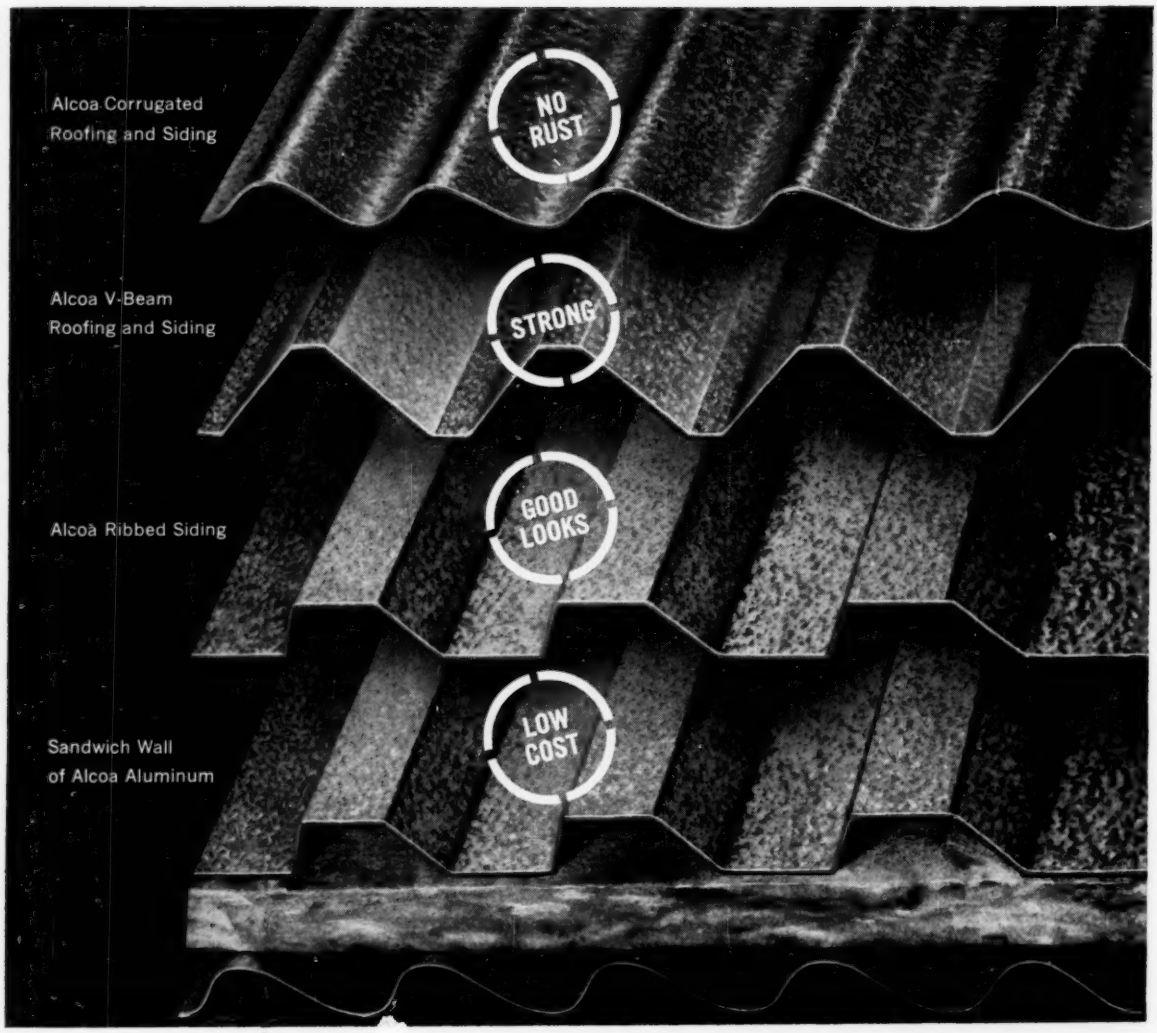
SARAN LINED PIPE COMPANY
DEPT. 2002A
2415 BURDETTE AVENUE
FERNDALE 20, MICHIGAN

Please send me information on: ☐ Saran lined pipe, fittings and valves ☐ Saran lined centrifugal pumps ☐ Saraloy 898 chemical resistant sheeting

Name_____ Title_____ Company_____

Address_____ City_____ State_____

YOU CAN DEPEND ON DOW



Four ways to beat corrosion

with ALCOA INDUSTRIAL BUILDING MATERIALS

Alcoa® Aluminum's natural resistance to corrosion is well established. It weathers well; never needs painting. Only insignificant changes in appearance and strength occur despite the most prolonged and intensive assaults of airborne grit, organic and inorganic vapors, chemical deposits—a wide range of corrosion hazards. Years of field experience provide conclusive proof.

Your choice of building characteristics is wider with aluminum, too. Alcoa Corrugated Roofing and Siding for rustfree endurance. Alcoa Ribbed Siding for long-lasting good looks. V-Beam Roofing and Siding for high strength safely carries 30-lb/sq-ft uniform load on a 10-ft purlin spacing. And for the lowest cost insulated metal wall system known—sandwich wall of Alcoa Aluminum, with a U value of .147, has three times the insulating value of 8″ brick.

GET THIS FREE BOOK. Alcoa's free 36-page book, *Alcoa Aluminum Industrial Building Products*, gives you full technical data and background on roofing and siding. Other data is available on windows, handrails, stair treads, tread plate, gratings and similar equipment. Ask your nearest Alcoa sales office, or write Aluminum Company of America, 856-D Alcoa Building, Pittsburgh 19, Pennsylvania.

ALCOA ALUMINUM
INDUSTRIAL BUILDING PRODUCTS
ALUMINUM COMPANY OF AMERICA

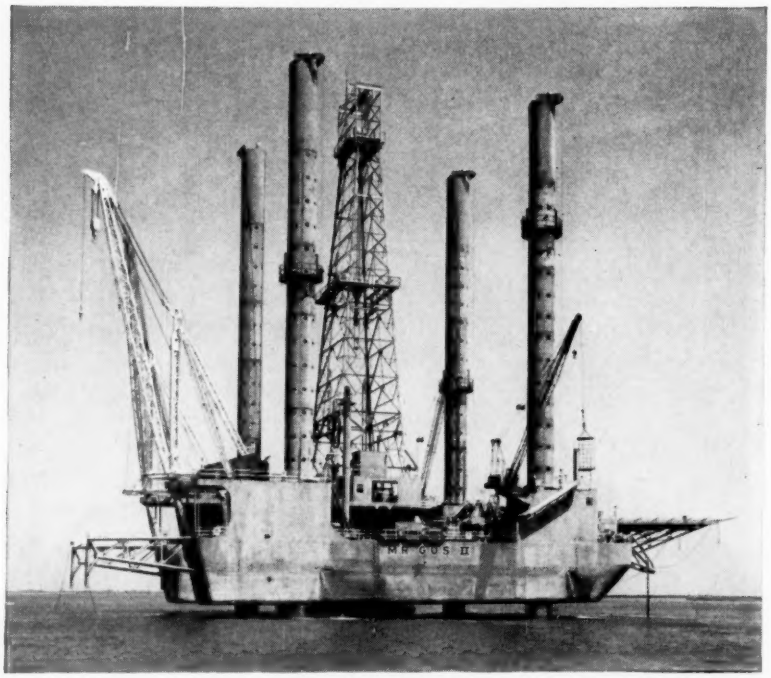
Your Guide to the Best in Aluminum Value

"ALCOA THEATRE"
Exciting Adventure
Alternate Monday Evenings

BETHLEHEM at BEAUMONT

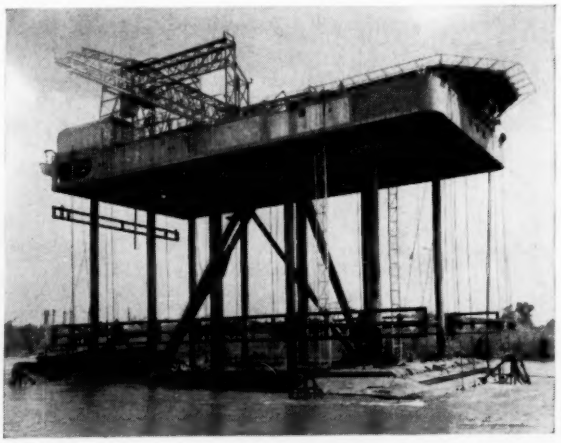
Pioneer

IN THE DEVELOPMENT, CONSTRUCTION AND OUTFITTING OF INTEGRATED SHALLOW AND DEEPWATER MOBILE DRILLING PLATFORMS



MR. GUS II
Platform 260′ x 104′ x 22′ Slot Length 57′ Width 50′ Sinking Depth 150′
Owner: C. G. Glasscock Drilling Co.

RAY TERRY
Hull 215′ x 52′ x 14′6″ Slot Length 90′ Width 11′ Sinking Depth 14′
Owner: Natural Gas and Oil Company



JIM WOODRUFF
Platform 190′ x 150′ x 12′ Slot Length 37′ Width 32′ Sinking Depth 75′
Owner: Penrod Drilling Company

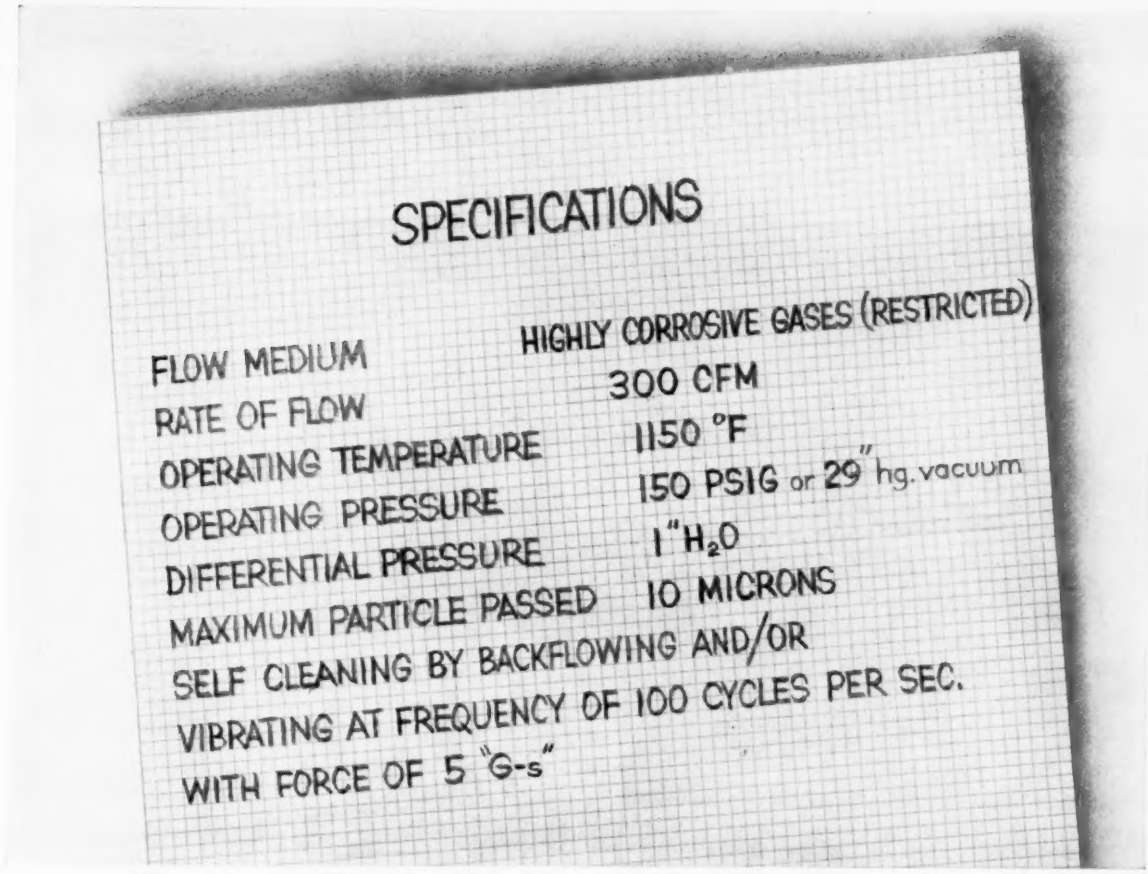
SHIP REPAIR YARDS
Boston Harbor, New York Harbor
Baltimore Harbor, Beaumont, Texas
Los Angeles Harbor, San Francisco Harbor

SHIPBUILDING YARDS
Quincy, Mass., Staten Island, N. Y.
Sparrows Point, Md., Beaumont, Texas
San Francisco, Calif.

BETHLEHEM STEEL
Shipbuilding Division

GENERAL OFFICES: 25 BROADWAY, NEW YORK 4, N. Y.

On the Pacific Coast shipbuilding and ship repairing are performed by the Shipbuilding Division of Bethlehem Pacific Coast Steel Corporation



Do you have filtration problems as tough as this?

PUROLATOR'S ENGINEERING SALES STAFF WILL HELP YOU SOLVE THEM

The requirements above are not hypothetical . . . they are typical of specifications to which Purolator has designed and built filters. The filtering elements designed for this application combine two forms of a porous metal media to obtain the required filtration qualities with the structural strength needed to withstand the punishment of the self-cleaning action – plus the temperature gradients and the effects of corrosive materials.

Purolator's engineering staff specializes in designing and building filters for difficult applications like this. The emphasis is on engineering, by a staff of "Q" and "L" cleared filtration experts, backed up by complete manufacturing facilities, able to produce filters or separators of any known media to operate within these wide ranges of conditions:

TEMPERATURES: from —420° to 1200° F.

PRESSURES: from a nearly perfect vacuum to 6,000 p.s.i.

RATES OF FLOW: from drop by drop to thousands of GPM.

DEGREES OF FILTRATION: from submicronic to 700 microns (in various media).

This complete filtration service, for the toughest problems in nuclear and chemical applications, is available only at Purolator. Purolator's engineers are ready to work on your requirements. If you have an *urgent* need for specially designed filtration systems, call Jules Kovacs, Vice President in charge of Research and Development and Product Application . . . or send him the details of your application.

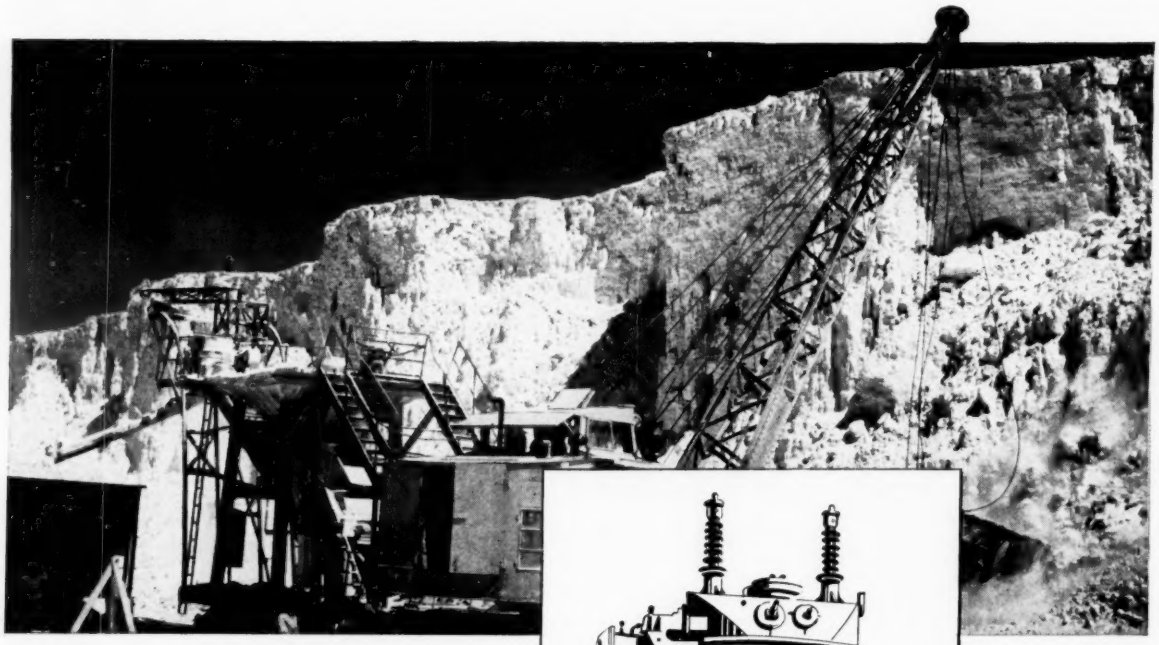
Filtration For Every Known Fluid

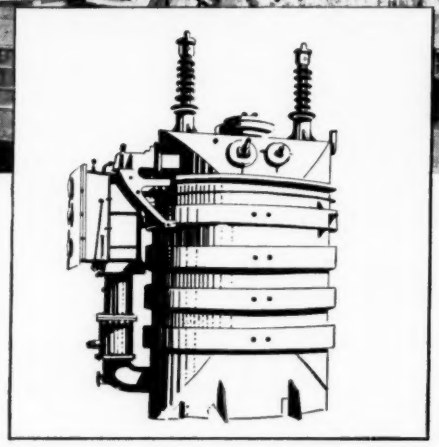
PUROLATOR

PRODUCTS, INC.

RAHWAY, NEW JERSEY AND TORONTO, ONTARIO, CANADA

SULPHUR *helps to create Headline Products*





SF_6

A new concept in transformer insulation

GAS INSTEAD OF OIL... *that is headline news!*

Sulphur Hexafluoride is a heavy, non-flammable gas and is both chemically and physiologically inert. These characteristics plus its high dielectric strength pin-pointed the heavy duty transformer field as a logical target. And so it turned out!

SF6 instead of oil is now being used in high voltage transformers with the following advantages:

- operations are much quieter
- lighter construction permissible
- less restriction in location
- lower maintenance
- fire-proof and explosion-proof

In SF6, the electrical and electronics industries are finding a very useful product providing both electrical insulation and cooling. As in so many 'headline' products serving industry, the element S is part of the chemical structure!

Texas Gulf Sulphur Co.

75 East 45th Street, New York 17, N. Y.
811 Rusk Avenue, Houston 2, Texas

Sulphur Producing Units
- Newgulf, Texas
- Moss Bluff, Texas
- Spindletop, Texas
- Worland, Wyoming

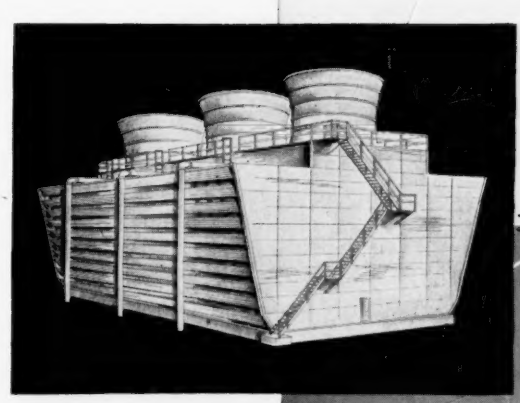
New Class 600

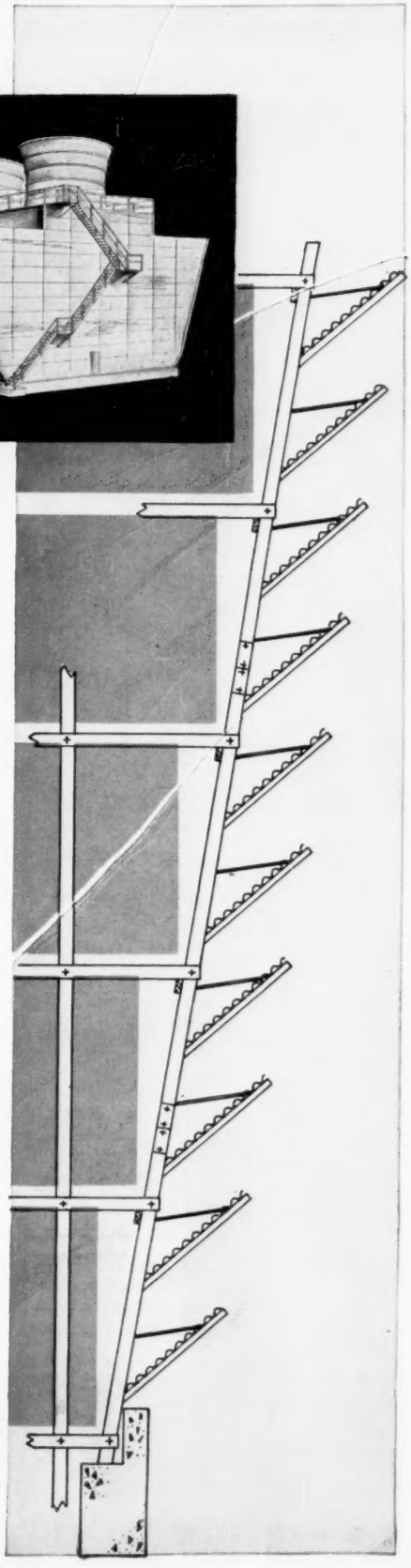
MARLEY

Double-Flow

has the

Profile with a Purpose





Comprised of a combination of "active" angles, the contour of Class 600 cooling towers is completely functional with positive influence on performance and operation. Each angle has its specific purpose and, in conjunction with the others, creates additional advantages.

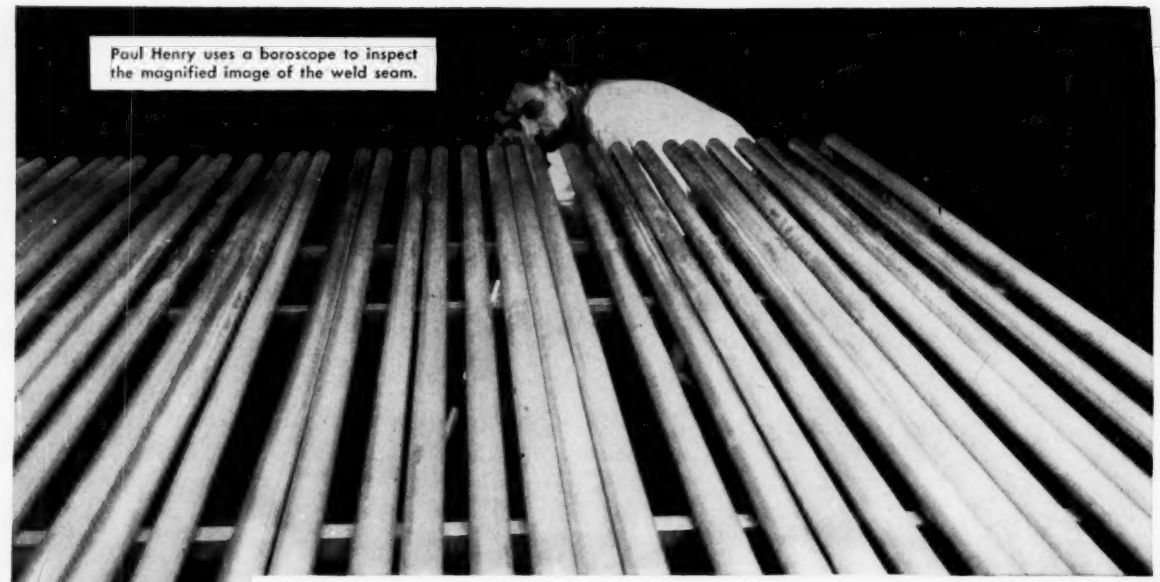
Louver Angle: The 42-inch louvers are positioned on 3-foot centers at an angle of 40° from horizontal. This arrangement readily admits more air to do more cooling—with inherent lowering of static drop, higher working velocities in the fill become completely practical. It increases the atmospheric performance potential (always greatest in cross-flow towers) and it eliminates splash-out.

Structural Angle: The 10° angle outlined by the louver posts is of equal importance. It makes possible uniform fill width or uniform *air travel* at all levels in the cooling chamber. Result: more performance per cubic foot of structure gained through efficient air utilization.

Fill Angle: With a uniform fill-to-louver distance maintained at every fill story, Class 600 Double-Flows set up an effective barrier against icing. The normal *water travel* creates a continuous curtain of water between fill and louvers without splash-out. There are no non-functional voids so the heat of the water prevents formation of sheet ice and blocking of air entrance.

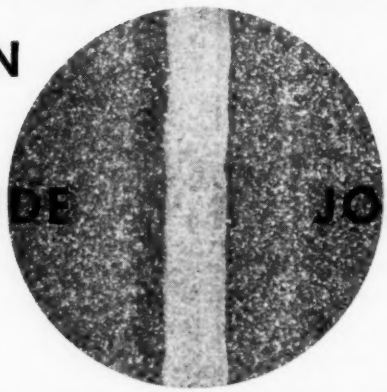
MARLEY **The Marley Company**

Kansas City, Missouri



Paul Henry uses a boroscope to inspect the magnified image of the weld seam.

INSPECTION WITH US IS AN INSIDE JOB



Damascus checks the inside as well as the outside of every piece of stainless steel pipe and tubing. With the help of a boroscope, the weld seam is examined along its full length. Skilled inspectors sort out faulty tubes . . . eliminate possible failures. The Damascus stamp of approval is your assurance of a sound product, carefully selected to fill your order.

For prompt mill shipments of stainless steel pipe and tubing in a wide range of sizes and A.I.S.I. analyses, call Damascus direct — for local service call your nearest STEEL SERVICE CENTER.

AMERICAN STEEL WAREHOUSE ASS'N

Write for free catalog.

DAMASCUS TUBE COMPANY

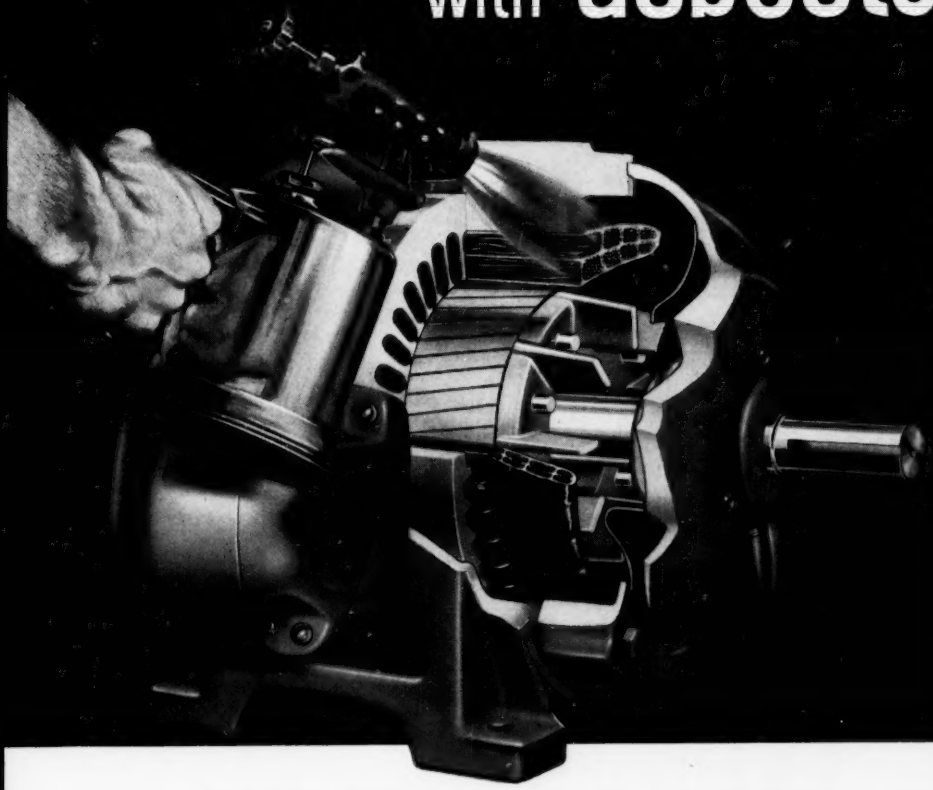
STAINLESS STEEL TUBING AND PIPE

GREENVILLE, PENNSYLVANIA

FORMED STEEL TUBE INSTITUTE

only **U. S. MOTORS**

insulates all windings with asbestos!



your best protection

against
motor burn-out
and
production
shutdowns

Only U.S. offers this protection! ALL windings insulated with asbestos—nature's million-year-old insulating material that *cannot carbonize!* Many motor makers use varnished paper, cloth, oiled linen, press-board, fish-board—even insulating varnish alone. All these will carbonize... not one is fire-proof!

Only the original, patented U.S. ASBESTIC PROCESS—gives you: 1—*Heat resistance*... can't carbonize, 2—*heat conductance* better than any cellulose material, 3—*moisture resistance*... due to exceptional impregnation and coating of windings.

Protect yourself against costly production shutdowns due to motor burn-out! Be sure to specify: "U.S. MOTORS"!

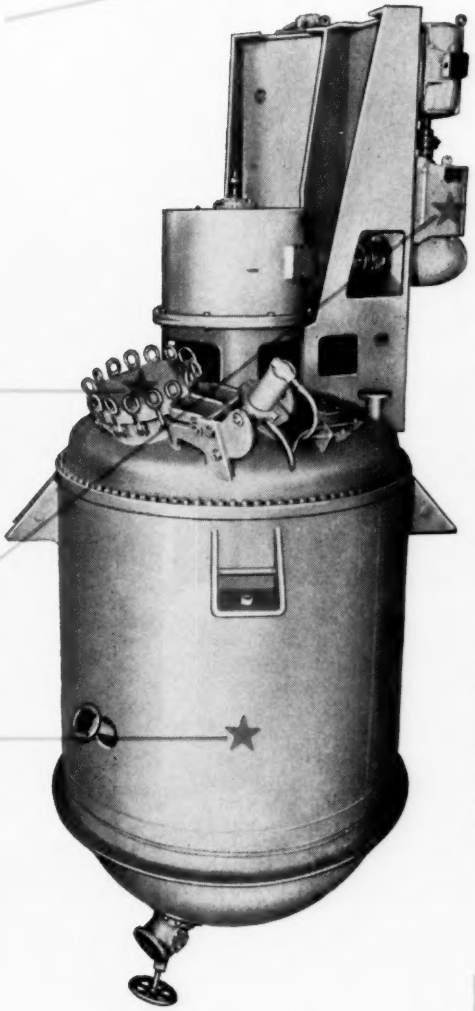
U.S. ELECTRICAL MOTORS INC.

BOX 2058, LOS ANGELES 54, CALIFORNIA
OR MILFORD, CONNECTICUT

FREE COLOR-ILLUSTRATED BROCHURES
For specific data on asbestos protection, write for General and Type H Uniclosed Bulletins.

13,500 POUNDS of GREASE

every 8 hours!



Struthers Wells

DOUBLE MOTION GREASE KETTLE

This is a stainless steel grease mixer recently completed for one of the major oil corporation's grease plants in Texas. All parts in contact with the mix are made of clad or solid type 304 stainless steel.

Note particularly the new vertical drive arrangement that permits maximum aisle clearance around the unit . . . also the newly-designed hydraulic-operated manhole with special built-in safety features. These are typical of Struthers Wells leadership in modern, efficient grease making equipment.

Are you searching for improved efficiency in your mixing operations? Struthers Wells will help you find it quickly with equipment designed to meet your specific requirements.

STRUTHERS WELLS *Corporation*

WARREN, PA. Struthers Wells **Plants at Warren and Titusville, Pa.**

Representatives in Principal Cities

STRUTHERS WELLS PRODUCTS

PROCESSING EQUIPMENT DIVISION
Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

BOILER DIVISION
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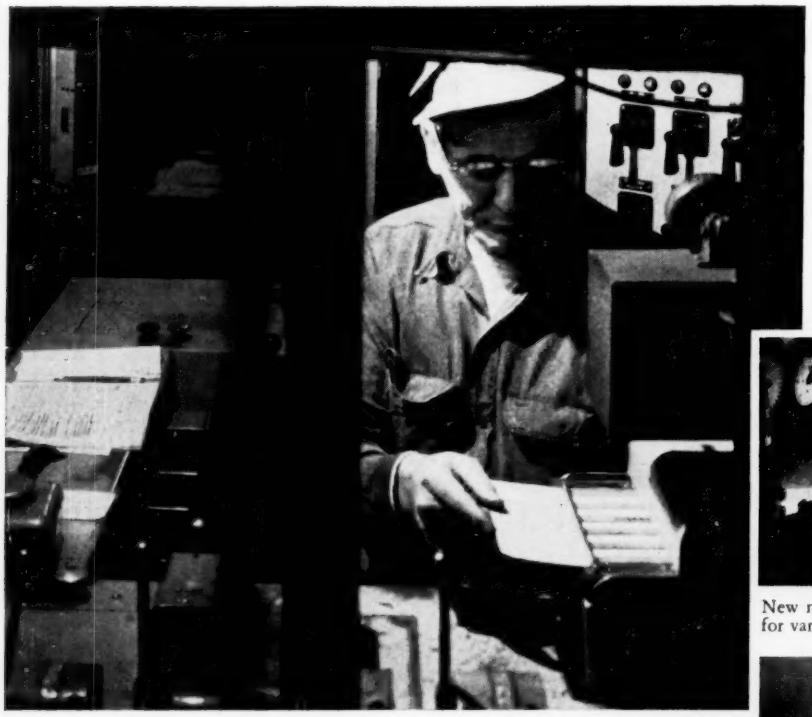
THE WORLD'S FIRST CARD-OPERATED MILL,

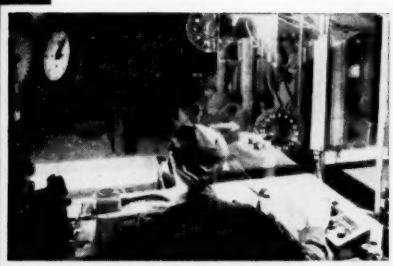
PROMISES YOU BETTER STEEL—AUTOMATICALLY



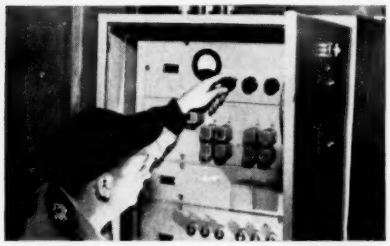
HIGHER QUALITY

MORE
UNIFORM SIZE

BETTER
PHYSICAL PROPERTIES



New method provides a large file of schedules for various types of steel.



General Electric engineers, working closely with AL personnel, developed and installed the control systems which regulate the mill.

Better quality, more uniform steel is the result.

A NEW punch-card control system, recently installed on the 56″ universal roughing mill at Allegheny Ludlum's Brackenridge, Pa. plant, is advancing mill standards of quality control.

Here's how it works: Allegheny Ludlum rolling experts predetermine optimum rolling procedures for the type of steel desired and translate this data into punches on an IBM card. These punches represent the proper screwdown settings, mill speed and number of passes. When the mill schedule calls for it, the mill operator in the pulpit simply selects the proper card, inserts it into the card reader, and he is ready to roll. As the operator makes each pass, the mill is automatically adjusted for each additional pass required. The rolled material is held uniformly to desired dimensions, and day in, day out it proves to have better, more constant physical properties.

It's easy to see how this kind of progress fits into your interest in consistent high quality. By performing rolling operations exactly the same way time after time, this new unit further assures Allegheny Ludlum customers that they are getting the best possible product from the industry's pioneer producer.

Let us talk over your requirements with you. Write us, or call the Allegheny Ludlum sales office nearest you, and an AL sales engineer will help you with any problem. ***Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania.***

WSW 6628

PIONEERING on the Horizons of Steel

Allegheny Ludlum

AL ALLEGHENY LUDLUM ®

ALLIS-CHALMERS

Dielectric Heaters

The application list is growing...

- ✓ Drying cellulose sponge
- ✓ Setting resin adhesives for wood bonding
- ✓ Gelling, curing, drying foam rubber
- ✓ Drying crumb rubber for Mooney test control
- ✓ Curing resin-impregnated paper
- ✓ Setting twist for rayon cord
- ✓ Heating plastic preforms
- ✓ Laboratory and research projects

Allis-Chalmers dielectric heaters are available in a complete range from 3 kw to 100 kw.

You, too, can

cut costs • save space • speed production with Allis-Chalmers dielectric heaters

Processing time measured in minutes . . . maximum production per unit of floor space . . . streamlined work flow . . . minimum heat loss . . . improved working conditions . . . simplified operation — these advantages are yours with the Allis-Chalmers dielectric heater.

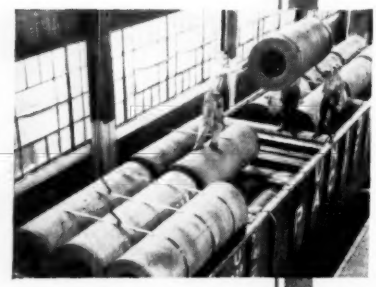
If your processing requires the heating of non-conducting materials, the application of Allis-Chalmers dielectric equipment and engineering will mean faster production and lowered costs. The experience gained by Allis-Chalmers engineers in designing hundreds of dielectric and induction heating installations is available for your operations.

See your nearby Allis-Chalmers representative or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin. Ask for bulletin 15B6431C.

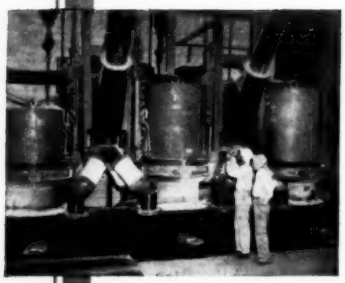
ALLIS-CHALMERS

A-5303

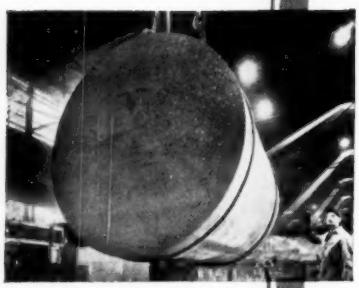
EDITED BY T. PETER FORBATH



35-in.-dia. electrodes, rolling off the production line, handle the power needs of today's standard big submerged arc furnaces.



45-in.dia. electrodes, moving into limited production, equip the huge 45,000-kva. furnaces fast gaining industry adherants.



60-in.-dia. electrode, the first and only one of its size, now awaits the giant furnace of the future, soon to be built.

National Carbon, pioneering the manufacture of ever larger "giant" electrodes, backs trend to huge arc furnaces.

Making Giant Electrodes: Problems Magnified, Too

Out front, the first act curtain's gone up on a rapidly burgeoning processing trend. Huge submerged arc furnaces—with power ratings now hitting levels once considered impractical and promising to climb still higher—are fast becoming standard equipment in the phosphorus, calcium carbide and ferroalloy industries.

An impressive case in point: Shea Chemical's 45,000-kva. elemental phosphorus furnace pictured above. (*Chem. Eng., Dec.* 1956, pp. 120-122.)

Backstage of this trend, and wielding a mighty influential hand in its direction, stands National Carbon Co. For credit this outfit with pioneering the ever larger "giant" electrodes needed to handle the big power demands of these huge furnaces.

Now, at its Niagara Falls, N. Y., Columbia, Tenn. and Clarksburg, W. Va. electrode facilities—each hefty benefactors of the company's just-completed 7-yr., $50-million expansion program—National Carbon turns out carbon and graphite electrodes ranging in size up to 45-in.-dia. by 110-in.-long. Three of the 45-in. giants make Shea's furnace the "biggest on stream".

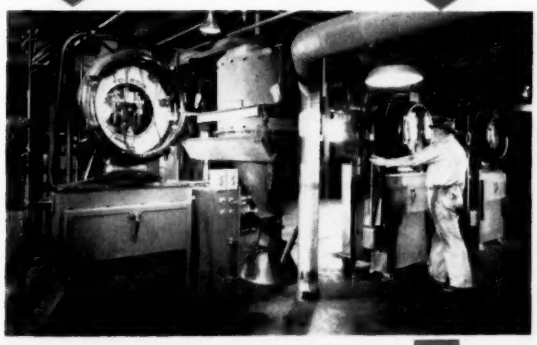
But National Carbon sees the day fast approaching when 50,000 and 60,000-kva. furnaces will take this title away. Thus, within the past few months word has come that electrodes up to 60-in.-dia. have rolled off National Carbon's production line, destined for furnaces of the future.

▶ **Bigger the Better**—What's the attraction of the huge furnaces? Not on any empty quest for "biggest" titles, furnace operators are hard-headedly after these

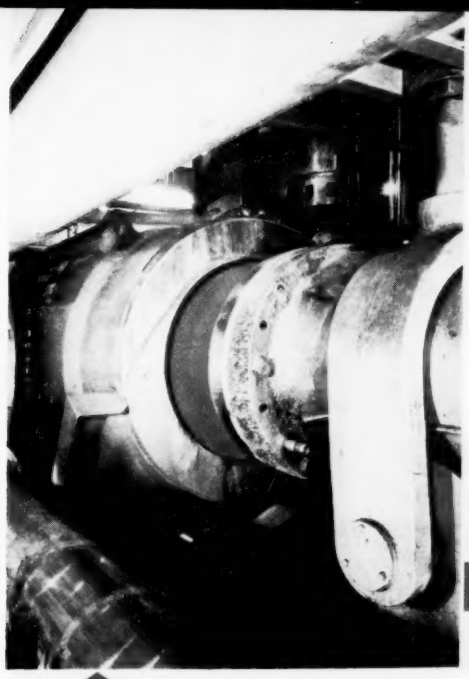
Unfold Flowsheet

Coal-base or petroleum coke

Coal-tar pitch



WEIGHING: 4,000-lb. batches of petroleum or coal coke and coal-tar pitch are automatically weighed out within tolerances of 4 lb./batch.



EXTRU
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MIXER: Steam through mixer jacket melts pitch; paddle wheels disperse it to coat coke particles.

handsome capital and operating cost savings offered by the big machines:

• Lower initial cost per unit of power since one big furnace costs less to build and install than two half-size units.

• Lower labor costs per ton of product since it takes, essentially, just about as much manpower to operate and maintain a big furnace as it does a small one.

• Lower power cost per ton of product since the huge furnaces operate at higher thermal efficiencies than small ones while sacrificing nothing in electrical efficiency.

And while there's an upper limit in furnace size where these points will no longer hold, industry experts agree that to date it's still far out of sight. Right now, it's a case of "the bigger the better". As furnace ratings are boosted, economies become more pronounced.

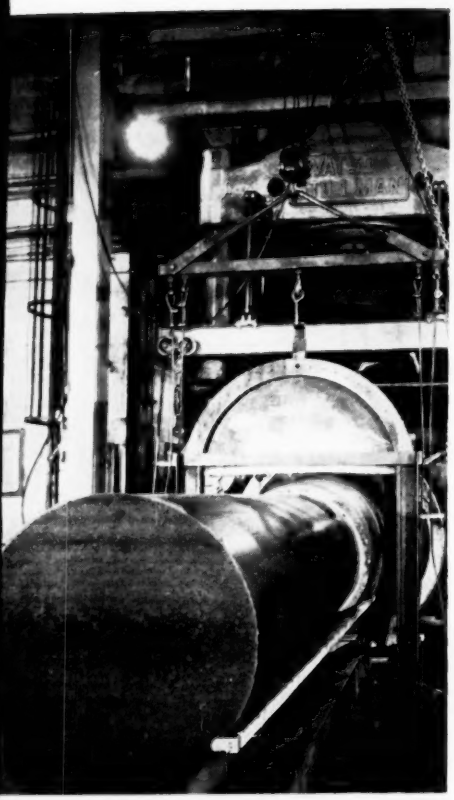
▶ **Giants Magnify Problems**—To a very large extent, the top limit in furnace size is set by the sizes of electrodes available. And that limit is yielding to National Carbon engineering.

What does it take to turn out the giant electrodes? As National Carbon's Fred O'Mara puts it, "It's mostly a matter of coping with the same problems we face in the manufacture of smaller electrodes—but, naturally enough, now they're magnified to a giant scale."

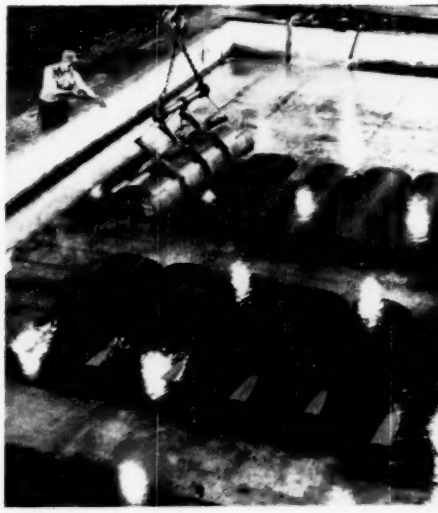
For example, this point is clearly illustrated at the baking stage of the electrode-making flowsheet. There, as volatile materials are driven from the preformed green electrode, the electrode shrinks markedly and almost suicidal internal stresses and strains that could ruin the product are set up in it. The larger the electrode, the more severe—and, consequently, more dangerous—do these stresses and strains become. Thus, a critical concern of National Carbon engineers in the manufacture of giant electrodes is rigorous control of the baking rate.

And very much the same sort of situation arises at the electrode-forming stage. There, extrusion rates must be carefully controlled. Too, experience shows

SION RAM delivers about
i. to cooled mix in horizon-
ced mud cylinder. Cylinder
ded in vertical position.



EXTRUSION DIE for 45-in.-dia. electrode must have flawless surface, so gets special dressing before being hooked onto cylinder.



EXTRUSION PRESS: Ram forces mix through die at other end of cylinder. Guillotine-like knife cuts electrode to length.

that exceptionally lose attention must be paid to the selection and treatment of the raw materials that go into the manufacture of electrodes of the 45-in.-dia.-and-up class.

▶ **Making Carbon and Graphite Giants**—Here's a rundown of the manufacturing procedure at Columbia, Tenn.—the world's largest electrode facility—where both carbon and graphite electrode giants are produced.

In the manufacture of carbon electrodes, anthracite-coal-base coke serves as the chief raw material; in graphite electrodes petroleum coke is the starting material. For both, coal-tar pitch serves as a bonding agent. These materials begin their journey down the flowsheet from the top floor of an 8-story building.

After a preliminary treatment, which includes milling and calcining steps, the raw materials feed via a system of vibrating conveyors through weighing hoppers to scales. There, 4,000-lb. batches of the materials are carefully weighed out within tolerances of 4 lb./batch. Each batch then flows by gravity to mixers on the floor below.

▶ **Heat While Mixing**—These mixers, horizontally placed, cylindrical rotary units each with a 4,000-lb. capacity, are fitted with electric-motor-driven (75 hp.) paddle wheels, steam jackets and abrasive-resistant liners.

One batch is mixed in each machine for about 80 min. while 100-psi. steam passes through mixer's jacket, heating materials to about 160 C. Under these conditions, the bonding pitch melts (m.p. 100 C.), disperses uniformly through the batch and coats the particles and fines.

▶ **Flowsheet Branches**—From this point forward the flowsheet branches into two streams depending on the size electrode to be made. Electrodes of 45-in.-dia. and smaller are formed via extrusion. Larger electrodes, as the 60-in.-dia. giant, are molded.

For the extrusion operation, the hot mix from the mixers must first be cooled. Contents of two rotary mixers discharge to a traveling belt that feeds a horizontally placed, cooling tumbler with a capacity of 7,000 lb. Cold air is drawn through this unit by a fan

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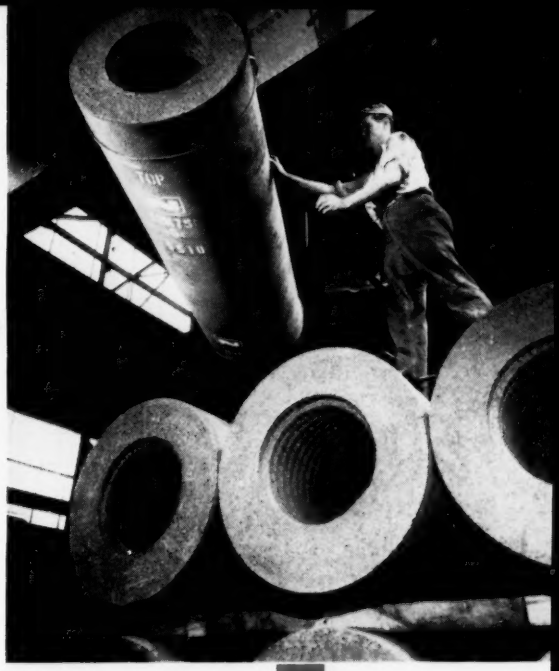
BAKING OVEN: Gas-fired burners deliver about 1,000 C. to electrodes packed in sand, drive off volatile materials.



PRODUCT: Threaded sockets are machined into electrode ends, then products loaded on rail cars.

COOLING BATH: Green electrodes from extrusion step are drowned in cold water where temperature drops to about 35 C.

Carbon or graphite electrodes (up to 45 in. dia. by 110 in. long)

s the tumbler rotates on its horizontal axis. Mix temerature drops to about 100 C.

Material, now ready to be extruded, travels on a conveyor belt to a chute through which it feeds a mud ylinder standing vertically on the floor below. About 2,000 lb. of mix is introduced to this cylinder for the anufacture of a 45-in.-dia. by 110-in.-long electrode.

Extrusion or Molding—While the mud cylinder is till standing in the vertical position, a tamping ram s applied to the mix. Then cylinder tilts over to the orizontal position. An extrusion die is located on one nd of the mud cylinder; a hydraulic extrusion ram, elivering about 3,000 psi., is applied to the other end f the cylinder. Mix is forced through the die forming he green electrode.

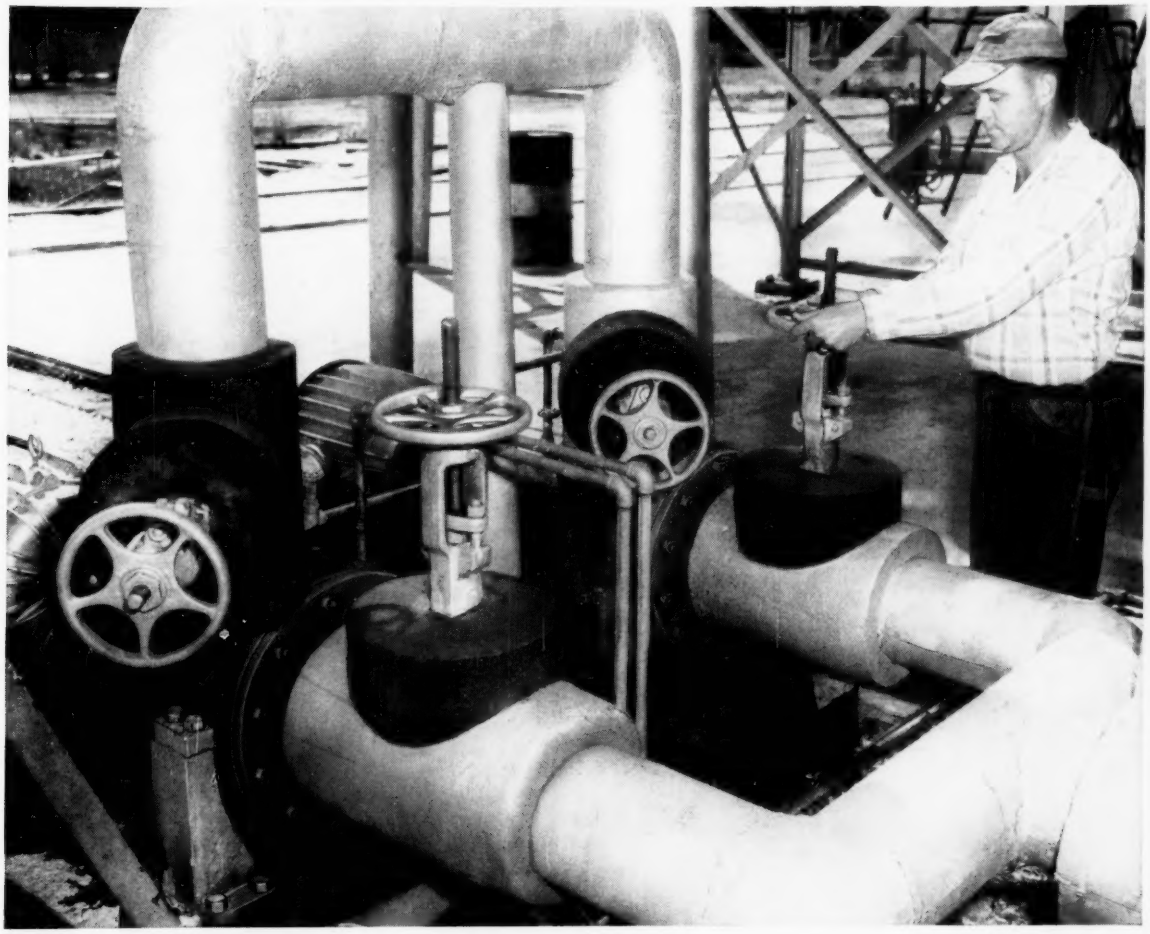
In the molding operation, for the manufacture of ieces upwards of 45 in. dia., the cooling step is ntirely bypassed. Hot material from the mixer, with consistency somewhat like that of stiff oatmeal, goes irectly into the mold.

Cooling and Baking—Green electrodes, either from extrusion press or mold, then are carried by a lifting clamp and overhead crane to a shallow cooling basin filled with water of carefully controlled temperature. There the electrodes are gently rolled back and forth manually until their temperature is about 30-35 C.

Gas-fired baking ovens measure roughly 10 ft. wide by 60 ft. long. Green electrodes, standing vertically in the ovens, are packed around with a granular coke-sand mixture. Combustion gases heat the electrodes to about 1,000 C. Baking period lasts about 45 days. Then, with the electrodes still packed under the coke sand to prevent their oxidation, the oven is allowed to cool to about ambient temperature.

At this point, the carbon electrodes are essentially complete. But the graphite electrodes, based on petroleum coke raw material, go on to an electric graphitizing furnace. There temperatures of 2,500-3,000 C. are generated via the electrodes own electrical resistance. Both carbon and graphite electrodes then have sockets machined carefully to close final tolerances and are stored, awaiting shipment to market.

CRANE Quality Saves Money for Crosby Chemicals, Inc.



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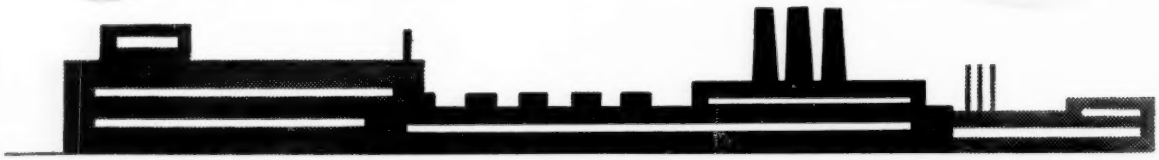

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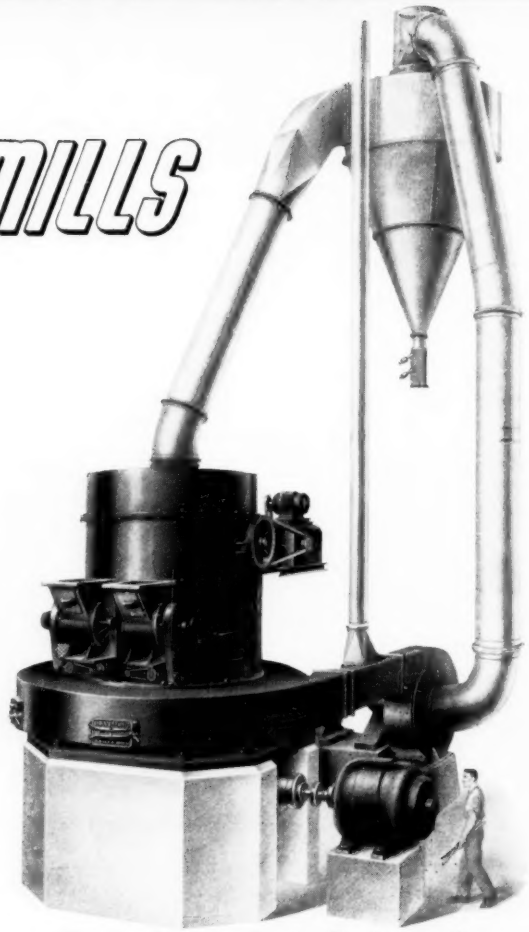

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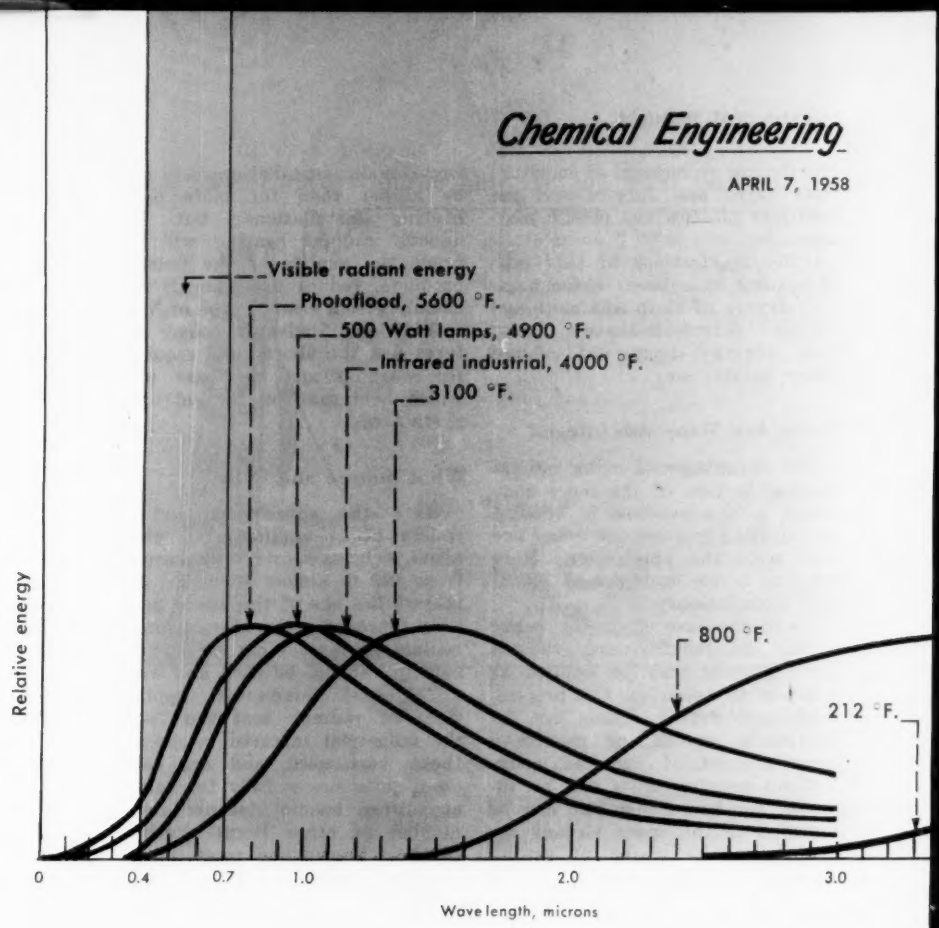
Chemical Engineering
APRIL 7, 1958



How to Design for Radiant Heating

To take the mystery out of radiant heat transfer, we begin a two-part article that will help you out-expert the "experts."

LLOYD M. POLENTZ, Engineering Consultant, Whittier, Calif.*

OF THE three different types of heat transfer — conduction, convection and radiation—radiation is the most difficult to understand. And the mystery surrounding the method in which energy can be transmitted across a vacuum has not yet been adequately explained.

This lack of understanding has led to two unfortunate developments. On the one hand, many engineers shy away from the use of radiant heating when it could be of considerable value; and, on the other hand, the field has been invaded by many heating "experts" who, regardless of the problem and completely undeterred by their own lack of understanding, always claim to have "just what you need!"

They have it for a price, of course.

It's not necessary to have a complete understanding of the theory underlying radiant heat transfer to make use of it in industrial processes. A knowledge of only a few of the fundamental principles will enable an engineer to either design his own equipment or to make an intelligent selection from the different types of radiant heating equipment now being offered on the market.

It will also help him to evaluate the competence of many of the self-styled experts who are willing and eager to sell him equipment.

Radiant heating has been used quite successfully in the past for a number of different purposes. Some of the most successful are the setting of paint and

*Meet your author on p. 182.

ink, drying or removal of moisture from paper and fabrics and the fusing of plastics and plastic coatings.

Other applications of this type of heating have been: space heating; drying of cloth and clothing; drying petroleum-based fuels; yarn drying; drying of colored water paints; etc.

There Are Many Advantages

The advantages of using radiant heating in lieu of the more commonly used convection or conduction heating systems are many and vary with the application. Here are just a few examples of industrial installations:

• In the case of drying paper during its manufacture, radiant heating units may be applied as boosters to speed up the process. Additional drying drums are expensive to install and require a large amount of valuable space. Radiant heating units can be installed for less money and can be installed in the space already occupied by the stacks of drying drums.

• Cloth-drying applications have proven feasible because low-temperature elements were used. This greatly reduced lint fire hazards.

• A playing card manufacturer installed radiant heating for drying lacquer on plastic sheets because of the ease of installation and low initial cost. Improved quality resulted from the more uniform heat control.

However, you'll want to remember that radiant heat is not universally applicable and in many instances fuel costs will be increased. Occasionally, installation costs may be higher than for more usual heating installations; but frequently radiant heating will improve the quality of the finished products, reduce fire hazards and usually give a cleaner type of heat.

Additional advantageous features are the short time required for warmup and the ease with which heat may be focused on a given area.

What Source and Why

Even the abbreviated list of radiant-heat applications given above includes source temperatures from 500 to almost 5,000 F.; and therein lies one of the major problems concerning the application of radiant heaters: What source temperature should be used and why?

The first commercial applications of radiant heat were with the industrial infrared lamps and these were used, and are being used, quite successfully for baking armatures, enamel, lacquer and a number of other items. Perhaps the best known and most impressive use was and still is the huge ovens used to give quick setting of the multicolored lacquer finishes on automobiles.

During the early period of industrial use of radiant heating, the term was synonomous with the use of infrared lamps, which operate at a temperature of about 4,100 F. and radiate partially in the visible range (see chart, p. 137).

To many "experts" today radiant heating still means infrared lamps. A few years after the first applications of infrared lamps to industrial heating problems, lower-temperature radiant heaters came into the market and with their advent the terms "far infrared" and "near infrared" became popular.

Far infrared describing the radiation from low-temperature sources—usually 1,000 F. or below—was of a long wavelength (greater than 2 microns) and "far" from the visible portion of the spectrum. Near infrared was the term used to describe the radiation from the high-temperature sources, such as tungsten, which emit energy in or near the visible portion of the spectrum.

As is the case with any new development, great claims were made for the effectiveness of the far-infrared radiators and the dilemma of the engineer considering the application of radiant heat was multiplied. Some of the investigators in the field of far-infrared radiators went so far as to claim fantastic thermal efficiencies—as high as 99.44%, and more. Such claims, of course, were not valid.

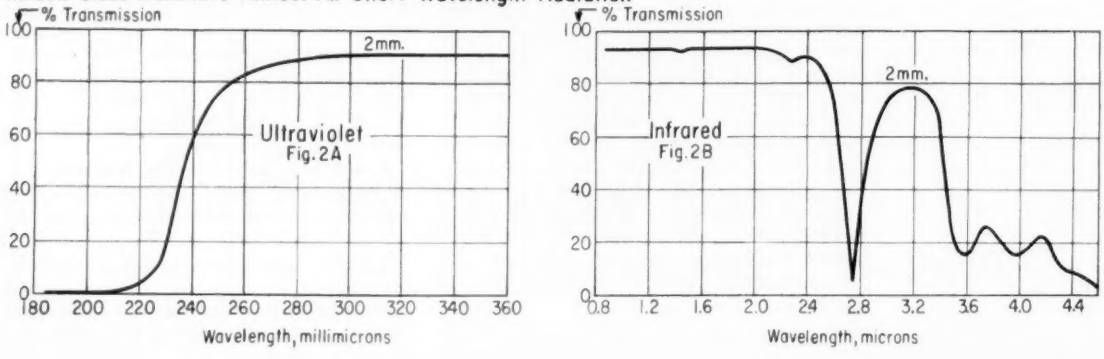
However, in general, the thermal efficiencies of the long-wavelength heaters exceeded that of the short-wavelength heaters, in those applications for which they were suited.

This is really the key to the whole problem: For what applications are the short-wavelength emitters best suited and for what applications are the long-wavelength emitters probably more satisfactory?

You Need Little Theory

As mentioned above, only a small amount of the theory of radiant heat transmission is really necessary for purchase or design of a

Window Glass Transmits Almost All Short-Wavelength Radiation



satisfactory radiant heat unit. This is because it's almost impossible to arrive at the optimum unit by means of theoretical calculations alone.

It's more satisfactory — and actually faster in most cases—to make the final determination by laboratory test. However, an understanding of the basic variables is necessary before you decide what to test and where you should begin.

Basic equation for radiant heat transfer between two parallel surfaces is:

$$q = i_f \sigma (T_1^4 - T_2^4)$$

where q is in Btu./hr.-sq. ft.; i_f is the interchange factor (see explanation below); σ is a constant equal to 0.173×10^{-8} Btu./hr.-sq. ft.-(deg. R.^{4}); T_1 and T_2 are the absolute temperatures of the absorber and emitter, respectively.

The interchange factor, i_f, is determined from the following relationship:

$$\frac{1}{i_f} = \left(\frac{1}{e_1} + \frac{1}{e_2}\right) - 1$$

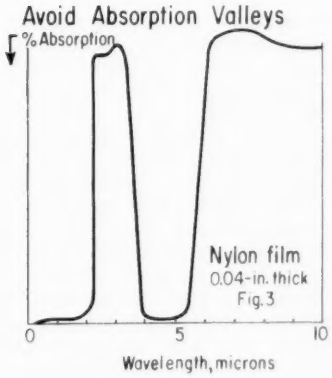
where e_1 and e_2 are the coefficients of emissivity of the radiator and absorber, respectively. (The coefficient of emissivity is equal to the coefficient of absorptivity.)

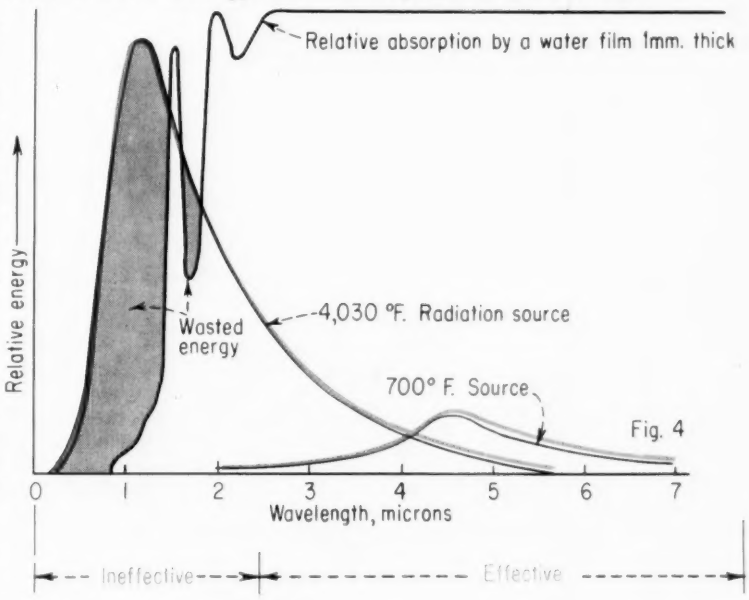
From the above equations we can see that the rate of heat transfer for a given temperature differential is proportional to i_f and that the values of e_1 and e_2 are quite significant. For example, if e_1 and e_2 are both equal to 0.8, then $i_f = 0.67$; but if e_1 and and e_2 are only equal to 0.4, then $i_f = 0.25$, and the rate of heat transfer would only be 37% as great.

It's important to remember that the coefficient of emissivity (or absorptivity) is a function of the temperature and can vary widely. An excellent example of this is window glass.

As we have shown in Fig. 2, window glass transmits almost all of the short-wavelength radiant energy from the sun. We know that on a cold day glass can remain cold even though the sun which shines through it warms a person standing on the other side. For long-wavelength radiation at 600 F., the coefficient of emissivity (and absorptivity) of glass is over 0.75, and at 72 F. reaches a value of 0.937.

This means that at lower temperatures, glass is almost opaque to radiant energy of long wavelength. This leads to another point which seems to be quite a common misunderstanding whenever the subject of radiant heating is discussed: the subject of color and its effect on the absorptivity or reflectivity of the incident beam of radiation.





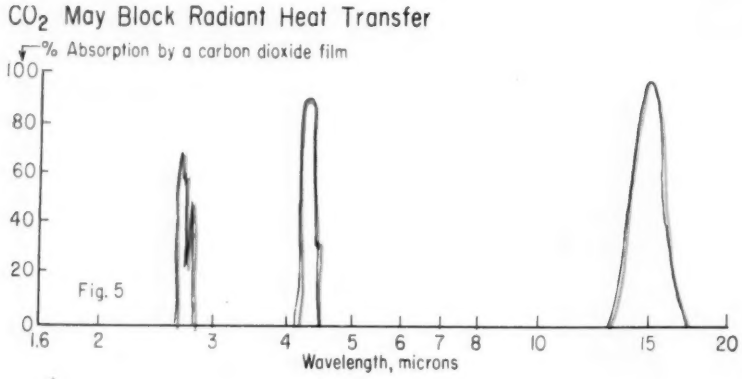
Color Has Little Effect

Color has little or no effect at wavelengths longer than 0.75 microns. Indeed, there is no such thing as "color" for radiant energy of wavelengths longer than the upper end of the visible range of the spectrum.

A brief review of reasoning to support this fact, and perhaps to make it more easily understood, may be in order. We know that both ordinary glass and thin films of water are relatively transparent to electromagnetic radiation in the visible range of 0.35 to 0.75 microns wavelength, and they transmit all colors equally well.

To the longer wavelengths, however, these two substances are comparatively opaque, transmitting only a small portion of energy in the so-called "far-infrared" region. Coupled with this is the fact that the "color" of opaque materials is actually a selective absorption of the visible spectrum, and it would seem, have little or no effect outside the visible range. From this it is evident that if radiant energy of wavelength greater than 1 micron is to be used, the color of the material to be heated is not a matter of importance!

We have discussed briefly the basic radiant heat transfer equation. In this equation a low interchange factor, i_f, in itself need not necessarily mean a low heat transfer efficiency; though it does mean that the area required to transmit a given amount of energy in a



given time must be greater than would be necessary with a large value of i_f. This is an important point. The efficiency of a radiant heating system is not, *per se*, determined by the coefficients of emissivity of the units forming the system.

True, the larger the radiator required to transmit a given amount of energy, the greater will be the losses due to heat "leakage" from the radiating source. A low coefficient of emissivity, by itself, however, does not mean low heating efficiency.

Absorptivity Is the Key

The coefficient of absorptivity of the object or substance being heated for the energy of the wavelength being transmitted is very important and can have a very marked effect upon the efficiency of the heating system.

Fig. 3 shows the absorption of radiant energy by a sheet of nylon 0.004-in. thick. From this figure we can see that if an infrared lamp were used as the heating source the bulk of the energy (which is below 2 microns in wavelength) would not be absorbed. Here the the color of the nylon would be of some theoretical importance because of the short wavelength of the emitted energy. The color would help determine the amount of energy reflected and the amount transmitted in the visible range.

However, this amount would be small and the color, even in this case, would be of little importance. The bulk of the energy would pass through the nylon film, and if the carrier were opaque to this wavelength, would be absorbed by the carrier. In such a case the energy would be largely lost. This particular film of nylon would be a difficult one to heat because of the "valley" between 4 and 5.5 microns. Perhaps the best choice for a source would be either a 2,840 F. radiator with a large portion of its energy in the 2- to 4-micron wavelength region, or the 600 F. radiator with a large part of its energy being transmitted above 5.5 microns.

Here, laboratory tests would be the best solution to determine both heating efficiency and quality of product.

A Case of Mismatching

Fig. 4 shows another case of a mismatched emitter and absorber. Here the absorption curve for a 1-mm. thick film of water is shown matched with the curve of radiant energy emitted by a 4,030 F. source.

The larger portion of the energy transmitted passes through the film. This energy will probably be absorbed by the material from which the water is being evaporated and will largely be lost. The energy from the 700 F. source would be almost entirely absorbed by the film of water, however, and a much better heating efficiency would be obtained.

In both of these examples the absorbing materials have been films and it should be mentioned that the curves of absorptivity vs. wavelength of incident radiation would be different for different thicknesses. Generally speaking the absorption will increase with thickness, although no specific relationship can be given.

From these two examples we can draw some general conclusions about radiant heat transfer:

1. Energy transmitted is proportional to the fourth power of the absolute temperature of the source.
2. Amount of energy absorbed is a function of the absorptivity relationship of the absorbing material and the wavelength of the emitted energy.
3. The size of a radiant heating system, measured by the effective Btu./hr. output can, in some instances, have little in common with the size of the system as measured by wattage input or Btu. input.
4. A radiant heating system which performs quite satisfactorily for heating one substance, may fail miserably if used to heat another substance with which it is not compatible.

Losses Through Gases

Since radiant heating theory is developed for transfer across vacuum, it's appropriate to discuss the loss of energy due to passage of radiation through air and other gases.

Fortunately, of the commonest gases, oxygen, nitrogen as well as hydrogen, radiate no heat and are perfectly transparent to foreign heat radiation. However, CO_2 and water are good radiators and good absorbers. Therefore, these two gases should be removed from the path of radiant energy transmission whenever possible.

Water vapor is particularly troublesome. When the temperature of the water film is raised to 212 F., the water will vaporize and any additional heat added is wasted. This means that the efficiency of a radiant-heat drying system is improved by making provision for the removal of the water vapor produced.

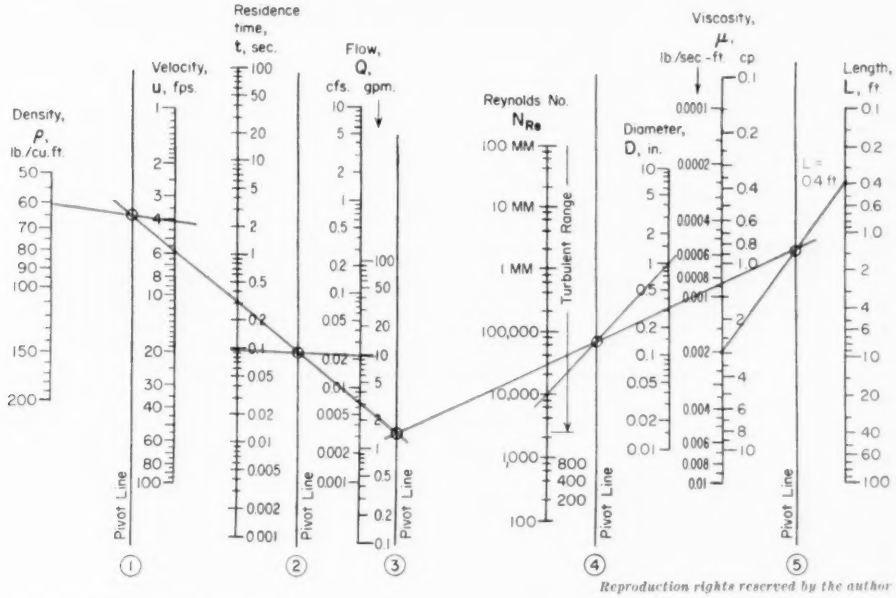
Coming Soon

With this brief discussion of fundamentals we're ready for laboratory testing, design of commercial equipment and selection of heating systems. Watch for Part II of this article, scheduled to appear in an early issue.

We'll consider wavelength of emitted energy; how much is absorbed; and the important question: what does it cost?

Solve Some of Your Mixing Problems With . . .

A Nomograph for Turbulence Mixers



Example: Find required pipe length *L*.

Given: $\rho = 60$ lb./cu. ft.; $u = 4$ ft./sec.; $t = 0.10$ sec.; $Q = 10$ gpm.; $N_{Re} = 10{,}000$; $D = 1.0$ in.; $\mu = 0.0020$ lb./sec.-ft.

Solution: Draw lines from ρ to *u*, *t* to *Q*, and N_{Re} to *D*. Connect intersection points on Pivot Lines 1 and 2. Extend line through Pivot Line 3. Connect intersection point on Line 3 with that on 4 to give pivot point on Line 5. A line from μ through last pivot point intersects *L* at answer of 0.4 ft.

J. G. LOWENSTEIN, Food Machinery and Chemical Corp., Baltimore, Md.

EFFICIENT application of any turbulence mixer, such as a pipe reactor or mixing tee, depends to a large extent on the engineer's ability to estimate certain operating variables. The working nomograph on the following page herds these stray variables together into a useful, accurate and efficient flock.

The need for such an implement is apparent. While normally straightforward, a large number of calculations by equation, for perhaps residence time or residence volume, can be very time-consuming. In addition, costly errors occasionally arise because of misplaced decimal points. The nomograph should therefore be a welcome addition to your stock of graphic tools.

The following general equation for flow-turbulence mixing relates operating variables to fluid and physical properties:

$$\rho u t Q = \frac{\pi}{4} D \mu L N_{Re}$$

This equation may be rearranged to solve for any one variable, provided that all others are known or can be estimated. Similarly, you must know any seven variables to use the nomograph, which is based on the equation.

Nomenclature

D	**Inside diameter of pipe or conduit, ft.**
L	**Length of pipe, ft.**
N_{Re}	**Reynolds number.**
Q	**Combined volumetric flow, cu. ft./sec.**
t	**Residence or holdup time, sec.**
u	**Velocity of mixed fluids through mixer, ft./sec.**
μ	**Viscosity of combined liquids, lb./sec.-ft.**
ρ	**Density of mixed fluids, lb./cu. ft.**

Here's how to use it

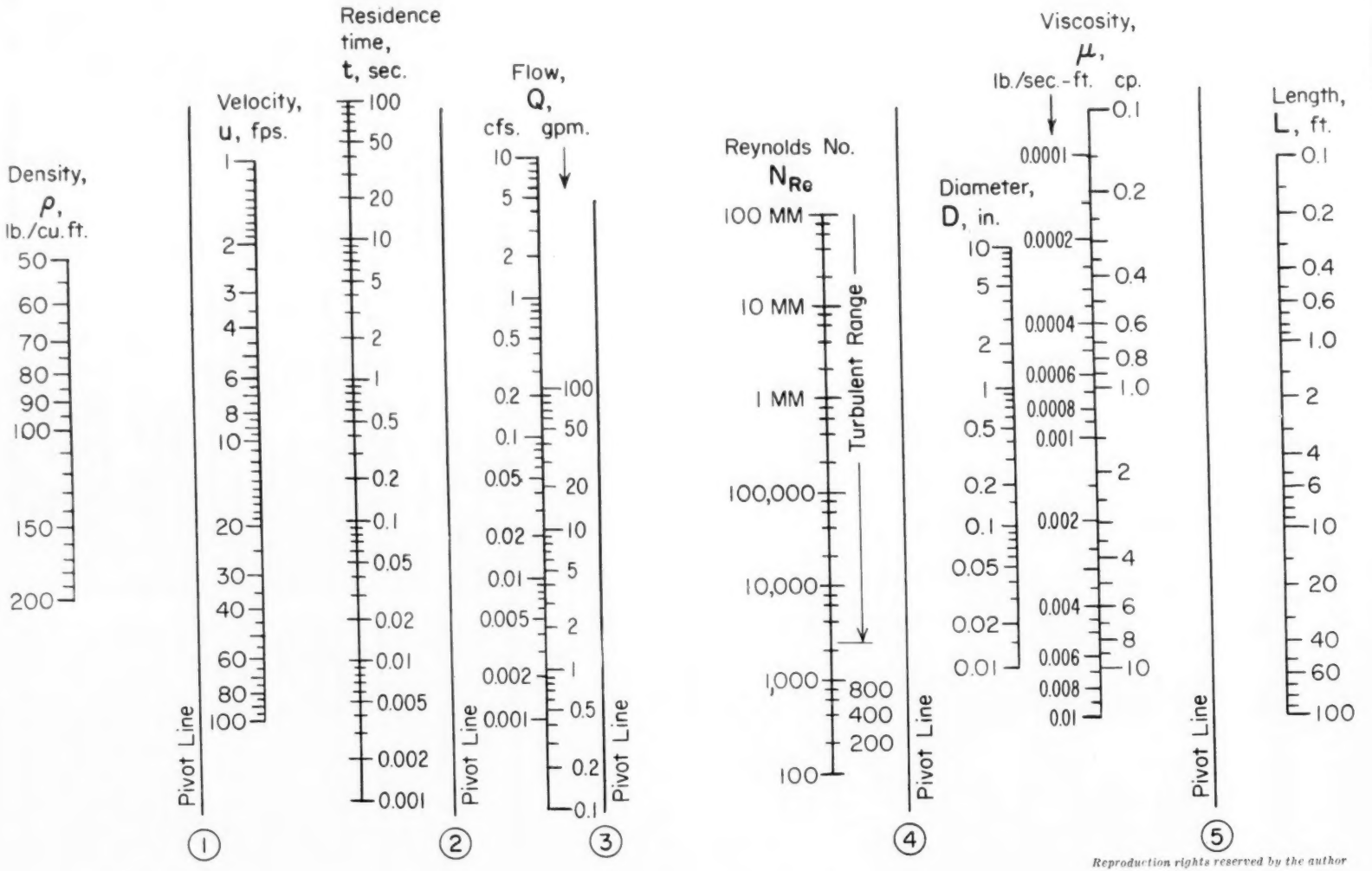
Note that the variables on the nomograph are grouped in sets of two about Pivot Lines 1, 2, 4 and 5. Pivot Line 3 is centrally located. Align the three sets of known variables, marking the intersection point on the proper pivot line. Now connect the points of intersection on Lines 1 and 2, or 4 and 5, with a straight line passing through Pivot Line 3.

Draw another line between the new point on Line 3 and the remaining pivot point, marking the line's intersection on the remaining unused pivot line. Finally, draw a line from the last known variable through this point, and read the answer for the unknown variable where its scale is intercepted.

Turn page for working chart

* To meet your author, see *Chem. Eng.*, Jan. 1958, p. 194.

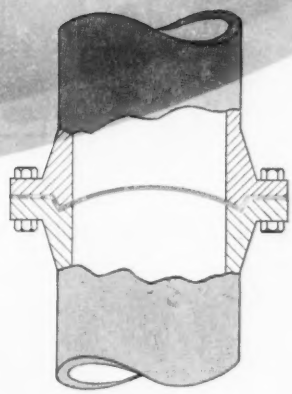
Estimate Turbulence-Mixing Variables With This Nomograph



Check Your Procedures on

Rupture Disk Installations

? Single or series arrangement
? Primary or secondary protection
? Horizontal or vertical position
? For high or low temperatures
? Overpressure or explosion protection
? Individual or manifold discharge



J. E. BIGHAM, Instrument Superintendent, The Chemstrand Corp., Pensacola, Fla.*

Rupture disks are nothing more than carefully designed weak-spots that let go at a predetermined pressure. Careful consideration must be given to the fact that after abnormal conditions no reseating is possible.

Before selecting a rupture disk as the pressure relieving device, the cost of the fluid relieved as well as safety particulars must be given close examination.

Where a relief valve is subject to excessive corrosion, gumming, inlet or outlet stoppages from material in the system, it is good practice to install a rupture disk in the pipe ahead of the valve. Accepted practice is to rate the disk at the valve set-pressure.

Rupture disks may be installed in the pipe ahead of a relief valve to avoid loss of valuable material by leakage. Also the rupture disk prevents deleterious materials from entering the valve until relief is necessary.

Rupture disks may be installed parallel with and supplemental to a relief valve. A typical arrangement is shown in Fig. 1. In such installations, the pressure relief valve is designed by the procedure specified in the earlier article. (*Chem. Eng.*, Feb. 10, 1958, p. 133.) Here the rupture disk is usually designed to relieve at 1.5 times the maximum allowable working pressure of the vessel. [ASME code, Sect. VIII states: use factor 1.2 times maximum allowable working pressure.]

A rupture disk may be installed on the discharge side of a spring-loaded relief valve. Consult the ASME code for "Unfired Pressure Vessels, Section VIII," and the rupture disk manufacturer before making such an installation.

When determining the size of disk needed for a particular relieving capacity, it is very important to examine the effects of low rupture pressure, corrosion and elevated temperatures. These conditions may necessitate use of a larger rupture disk to comply successfully with rupture pressure requirements.

Rupture disks burst at a stated temperature. Most rupture disks have a lower rupture pressure at elevated temperatures. There is a sub-zero temperature range in which some disks gain considerable strength. Consult manufacturers of rupture disks for operating temperatures on all disk installations.

Representative minimum pressure ratings and maximum operating temperatures of disks made from various metals and alloys are given in an accompanying table.

How to Allow for Corrosion

Corrosion dominates the behavior of rupture disks. The life of a rupture disk on corrosive service will be drastically shortened by what may be a relatively slight corrosive attack. Any disk material corroded by process materials must be replaced by a disk material unaffected by the process.

The possibility of increasing the diameter of a rupture disk should be given close examination. Sometimes, it is possible to gain an appreciable disk-life by obtaining a metal thickness that will withstand corrosion.

Manufacturing tolerances range from 8% under to 16% over desired

* For author biography see *Chem. Eng.*, Feb. 10, 1958, p. 173.

How Rupture Disk Gives Secondary Protection

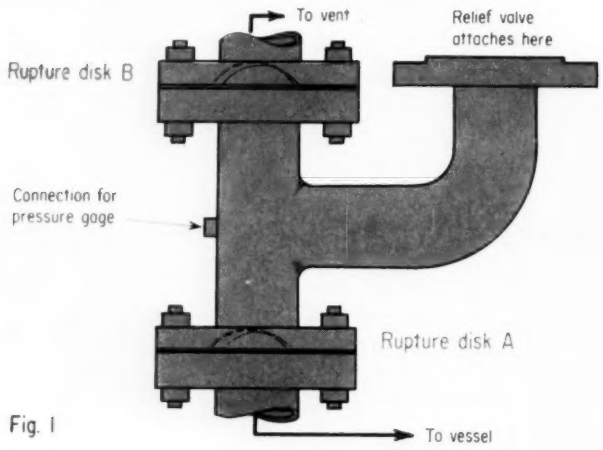


Fig. 1

Assembly Protects Relief Valve From Disk Fragments

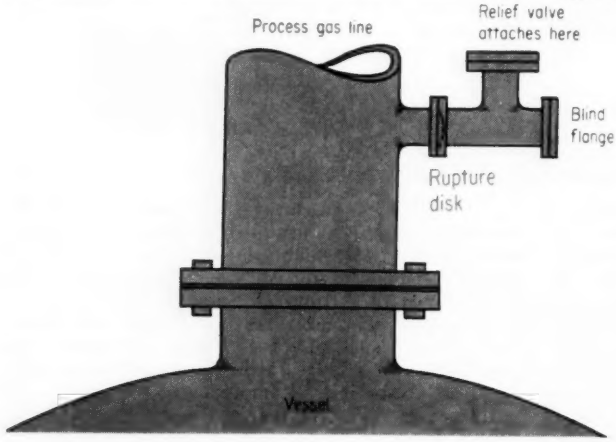


Fig. 2

Suggested Pressure and Temperature Values

	Representative Minimum Pressure, Psig. at 72 F. Disk Sizes					Representative Max. Temp., Deg. F.
	½-in.	1-in.	2-in.	4-in.	8-in.	
Aluminum	150	100	50	35	20	250
Carbon steel	1,750	750	300	175	125	...
Copper	400	200	75	50	40	250
Gold	600	400	190	120	...	...
Inconel	800	425	150	85	50	900
Monel	500	250	100	50	30	800
Nickel	700	300	135	110	75	750
Platinum	250	140	65	35	...	600
Silver	250	130	60	30	30	250
Stainless steel 302,321,347	1,000	460	200	100	60	600

rupture pressure for disks bursting below 45 psig. These tolerances are 3% under to 6% over desired rupture pressure for disks rated at 500 psig. or more.

Remember that disks are usually rated at the actual rupture pressure as determined by tests of disks from a given lot. Then the disk is guaranteed to rupture at plus or minus 5% of its rated pressure.

If manufacturing tolerances are not acceptable because of maximum allowable pressure on a system, code restrictions or process requirements, the vendor should be directed to design within an acceptable plus or minus tolerance of the specified rupture pressure.

The rupture pressure of a disk must not be greater than the code rating of the protected vessel. However, maximum normal operating pressure should be less than 67% of the designed rupture pressure of the disk. This procedure is based on conditions of installation on a system where pressure increments are gradual or non-pulsating and the temperature at the safety disk does not exceed atmospheric.

Where the rupture disk is exposed to a pulsating pressure or a condition of reversal between vacuum and pressure, design the rupture disk so that the process operating pressure is less than 50% of the disk rupture pressure.

Sizing of Rupture Disks

Calculation of an adequate rupture disk size depends on the

- Cause of overpressure.
- Rate of pressure increase.
- Required rate of discharge of fluid to prevent pressure rise within the vessel beyond its safe limit.

Consult the previous article (*Chem. Eng.*, Feb. 10, 1958, p. 133) for the conditions causing overpressure in various systems. Use the methods shown to find the required capacity for relief devices. This capacity can be used to calculate the area of either a spring-loaded relief valve or a rupture disk. Calculate preliminary disk area using the formula $A = C/11.4P$ where A = area, sq. in.; C = required capacity, cfm. of air and P = relieving pressure, psia.

A recent article, "Calculate Adequate Rupture Disk Size," (*Chem. Eng.*, Jan. 13, 1958, p. 157) presents a method of sizing disks when explosion causes the overpressure.

Data show the rate of pressure rise for a number of organic compounds. Also discussed are methods of calculating quantity of fluid to be relieved. For actual disk area, consult rupture disk manufacturer.

Installing Rupture Disks

The general requirements for installing relief valves (*Chem. Eng.*, Feb. 10, 1958, p. 133) apply equally as well to rupture disks. Also consider the following additional factors.

Where a rupture disk protects a relief valve, the method shown in Fig. 2 prevents disk material from entering and lodging in valve. If this method is not used, disk particles may prevent reclosure or restrict discharge area of the valve.

To facilitate drainage, install rupture disks with their diameter in the vertical plane. Where this is not feasible, installing the disk with the diameter in the horizontal plane is acceptable. The drain hole on the discharge side of the rupture disk also prevents back-pressure from building up. These methods are shown in Fig. 3.

If the rupture disk is affected by corrosion, erosion or subject to premature failure because of fluctuating pressure, a series disk arrangement is desirable. For the installation shown in Fig. 4, each disk is rated at required relief pressure. If the lower disk is ruptured or pin-holed, the top disk provides sufficient time for planned shut down to replace the disks.

Consider Back-Pressure on Disk

When an individual discharge line to flare or remote vent is used from a rupture disk, the maximum allowable back-pressure is 10% of the disk rupture pressure. This low value is necessary because of manufacturing tolerances and guaranteed rupture pressure deviation. The back-pressure may be 15% if manufacturing tolerances are specified to be within plus or minus 5%.

Back-pressure for manifold discharge piping including one or more rupture disks and relief valves is determined as follows. Minimum allowable back-pressure is not more than that determined for the lowest rupture pressure of the included disks or 25% of the lowest set-pressure of the included valves, whichever is less.

Side Drain Stops Back-Pressure and Lessens Corrosion

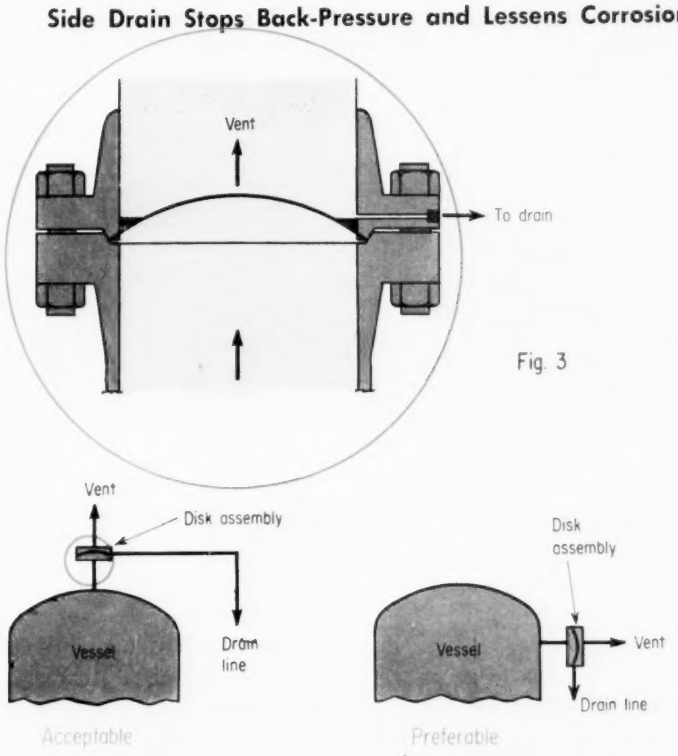


Fig. 3

Use Rupture Disks in Series For Added Protection

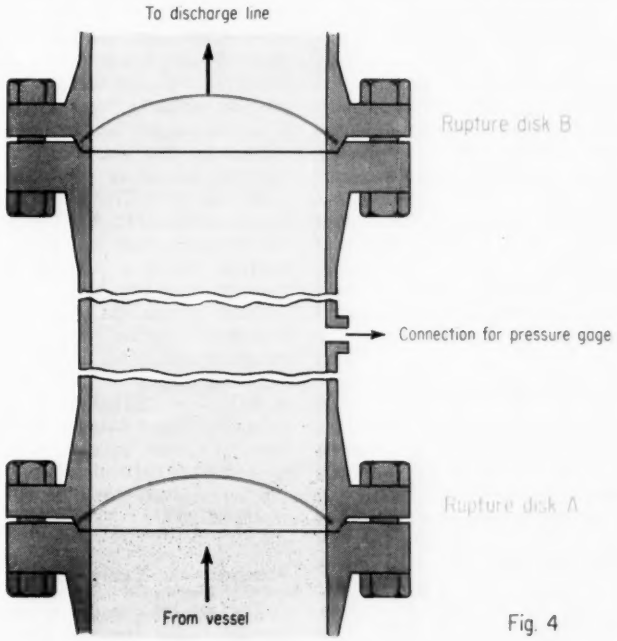
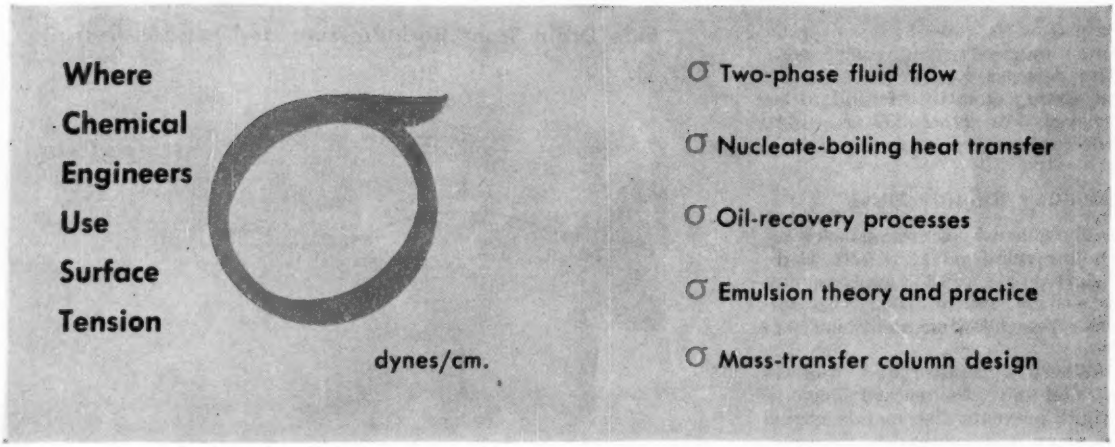


Fig. 4



Surface Tension for Pure Liquids

Beginning a new section of this popular series of articles. Here are methods you can use for estimating this important property.

WALLACE R. GAMBILL, Union Carbide Chemicals Co., Charleston, W. Va.*

Values for the surface tensions of liquids are now required in a number of correlations that are of interest to chemical engineers.

Some examples of technical areas where this property is important are: two-phase (vapor-liquid) fluid flow; nucleate-boiling heat transfer; oil recovery processes; emulsion theory; and distillation column design, where surface tension figures in the estimation of quantities such as interfacial area, plate spacing, slot opening, entrainment rate and liquid holdup (for packed columns).

Interfacial tensions are occasionally of value in extraction column calculations and in other liquid-contactor designs. We'll discuss methods for estimating interfacial tension in a later section.

Methods for Pure Liquids

The surface of a liquid phase is a region of high energy because molecules there come under the influence of fewer neighbors. Surface energy, E_s, is related to the more familiar surface tension, σ, by the thermodynamic relation:

$$E_s = \sigma - T(d\sigma/dT) \quad (1)$$

Only the quantity σ will be treated in this article and Eq. (1) may be used by the reader should he encounter E_s. Another quantity which you may run across is the "specific cohesion," a^2, where a^2 equals $(2\sigma/\rho_l)$.

Surface tensions for most organic liquids—particularly those of higher molecular weight—cover a narrow range at room temperature. Most values are between 25 and 40 dynes/cm. There are, of course, exceptions including polyhydric alcohols (up to 65), polysiloxanes and fluorocarbons (15 to 25). In fact, the fluorocarbons have the lowest surface tensions of any common general class of compounds.

Surface tensions of liquid metals are much higher, usually in the range of 300 to 600 dynes/cm. For Hg at 20 C., $\sigma = 476$; and for water at 20 C., $\sigma = 72.75$ dynes/cm. When using published data on surface tension, it's best to choose data acquired after 1916; prior to that date published data are in error by as much as 20%.

Tension vs. Temperature

Surface tension decreases almost linearly with temperature, becoming zero at the critical temperature. This behavior is shown for water in Fig. 1. In many cases σ vs. T is a nearly linear function up to a reduced temperature of about 0.8.

In any experimental determination it is, of course, the temperature of the meniscus—and not the liquid bulk temperature—that characterizes the surface tension. According to Weissberger[1], the temperature dependence of surface tension of water is given by:

$$\sigma = 75.680 - 0.138t - (3.56 \times 10^{-4})t^2 + (4.7 \times 10^{-7})t^3 \quad (2)$$

The effect on σ of the gas or vapor above the liquid is quite small, usually less than 0.5%, and very rarely above 2%. Values of σ reported in the literature are usually for the pure liquid in contact with either its saturated vapor or with air. Tamamuski[2] found that for different gases with the same liquid, the change in surface tension is proportional to the $\frac{1}{4}$ power of the solubility of gas in liquid.

Some Specific Methods

Surface tension has been correlated with many other properties: compressibility, latent heat of vaporization, vapor pressure, internal pressure, among many others. The

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best of these many methods will be discussed here.

Method 1—The Parachor Approach

Most generally useful of the many available methods for estimating surface tension are doubtless those involving the parachor. Both parachor, [P], and molar refraction, [R_D], were discussed in an earlier article of this series,[3] in which we presented a table of additive constants for both quantities.

It may be well to review the developments that preceded the modern parachor approach; they went somewhat as follows.

Method 1a—Eötvos

Eötvos,[4] in 1886, proposed that

$$\sigma = k(T_c - T)(\rho_l/M)^{0.667} \qquad (3)$$

Seven years later, Ramsay-Shields[5, 6] proposed that $(T_c - T)$ be replaced by $(T_c - T - 6)$ for a better fit of the data. Still later, Katayama[7] proposed yet another modification of the Eötvos equation by including vapor density, as follows:

$$\sigma = k(T_c - T)\left(\frac{(\rho_l - \rho_v)}{M}\right)^{0.667} \qquad (4)$$

The "Eötvos constant," k, of these three proposals is approximately 2.12 for "normal" (unassociated and nonpolar) liquids, such as CCl_4 and C_6H_6. However, k is smaller than 2.12 for polar liquids such as water, acetic acid and alcohols; and greater than 2.12 for very high molecular-weight compounds. The variation of k is at least from 1.5 to 2.6, and these correlations are no longer acceptable except within their narrowly defined limits. Katayama's form is the best of the three, since it applies to a broader range of temperature.

Things began rolling in 1923 when Macleod[8] proposed his well-known empirical equation:

$$\sigma^{0.25}/(\rho_l - \rho_v) = C \qquad (5)$$

where C is a temperature-independent constant for a given substance. Considering its simplicity, this equation is remarkably accurate up to about 30 C. below T_c. For associated liquids, C is not quite constant and increases slightly with temperature.

Method 1b—Sugden

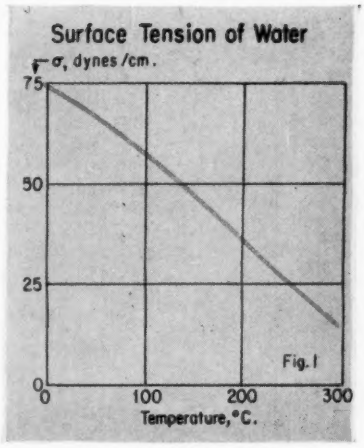
Sugden[9] first proposed the parachor in 1924 from consideration of and as an extension of Eq. (5). Almost at the same time, Ferguson[10] arrived at the same form by combining Eq. (4) with an equation of van der Waals to be considered later under the section on temperature dependence.

Some 13 years later, Fowler[11] showed that the Sugden parachor relationship may be deduced from theoretical considerations. Sugden defined his parachor this way:

$$[P] = M\sigma^{0.25}/(\rho_l - \rho_v) \qquad (6)$$

Eq. (6) may be simply obtained from Eq. (5) by multiplying each side by M, so that [P] is equal to Macleod's C times M.

Parachor is an additive property, nearly temperature-independent, and with only small defects connected with association. The greater the association, the greater the increase of [P] with temperature. Parachor, for most organics, is constant to within plus or minus ½ unit over a temperature range of at least 30 C.



Only slight variations are caused in experimental [P] values by structural isomerism. Two extensive compilations of parachors derived from known surface tensions are available.[12, 13] In addition to Sugden's original treatment of the parachor as related to the liquid state,[14] excellent modern critical analyses of the theoretical background have been given by Reilly & Rae[15] and by Thomson.[16]

When used for estimating surface tension, we convert Eq. (6) to:

$$\sigma = \left[\frac{[P](\rho_l - \rho_v)}{M}\right]^4 \qquad (7)$$

where ρ_v, vapor density, is to be evaluated at the given temperature and the vapor pressure of the liquid, i. e, under saturation conditions.

Around room temperature, an average deviation of about 3-4% may be expected. The parachor contributions of Mumford and Phillips given in a table in an earlier article in this series[3] may be used, as may the more complex but only slightly more accurate additive values of Gibling.[17]

For substances such as water and HCN, whose experimental and calculated parachors differ substantially, the results will naturally not be accurate. Such substances, however, are quite rare. Eq. (7) was used for five low-surface-tension Freons with good agreement by Plank,[18] for example. Johnson and co-workers[19] developed a convenient nomograph for Eq. (7) which we have reproduced as Fig. 2.

Nomenclature

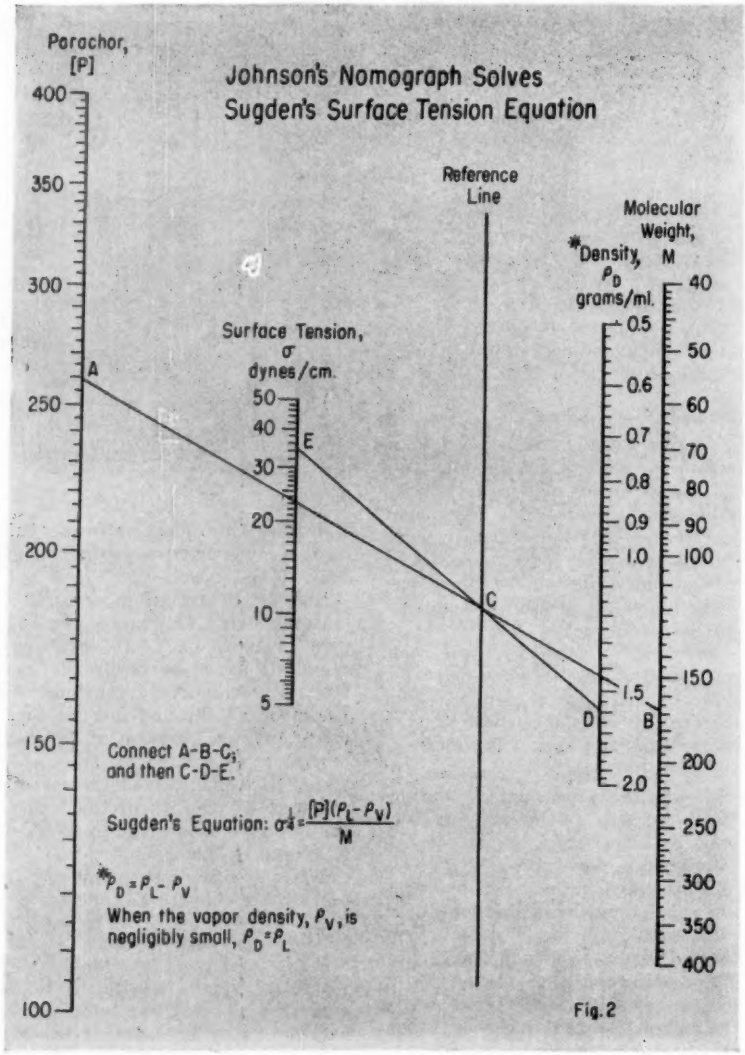
E_s	Surface energy, dynes/cm.
I	Viscosity constitutional constant.
L_v	Latent heat of vaporization at t_b, cal./gram.
M	Molecular weight.
n	Optical refractive index.
[P]	Parachor (see Eq. 6).
[R_D]	Molar refraction (see Eq. 12).
t	Temperature, deg. C.
T	Absolute temperature, deg. K.
T_c'	Pseudocritical temperature, deg. K.
V	Molar liquid volume at t, cc./gram-mole.
V_m	Molar liquid volume at t_b, cc./gram-mole.
x	Mole fraction in liquid.
y	Mole fraction in vapor.
μ	Liquid viscosity, millipoises.
ρ	Density, grams/cc.
σ	Surface tension, dynes/cm.
σ_i	Interfacial tension, dynes/cm.

Constants

A, C, k, K, m and p

Subscripts

b	At normal boiling point.
c	At the critical point.
D	Based on sodium D line.
i	At liquid-liquid interface.
l	For the liquid phase.
m	Mixture value.
o	At zero deg. K.
r	Reduced value.
R	Reference substance.
s	At saturation; also, values of Sugden (for parachor).
V	For the vapor phase.
1, 2	Denoting individual pure components; also, for different temperature levels for a given substance.



For the common case of negligible vapor density, Eq. (7) reduces to this form:

$$\sigma = \left(\frac{[P]\rho_l}{M}\right)^4 \qquad (8)$$

If liquid density is unknown and ρ_v is again neglected, the definitive equation for molecular volume:

$$V_m = M/(\rho_l)_b \qquad (9)$$

may be substituted into Eq. (8) to give the very simple form:

$$\sigma_b = \left(\frac{[P]}{V_m}\right)^4 \qquad (10)$$

The molecular volume, V_m, as originally defined by Kopp, is the molar volume of the liquid, in cc./gram-mole. at its normal boiling point. It may be calculated from Eq. (9), or the additive values of Le Bas[20] (see Table I) may be summed, as for the parachor.

The writer found that [P] is related to V_m, within about plus or minus 10% maximum deviation, by:

$$[P] = 2.1V_m \qquad (11)$$

which, when combined with Eq. (10), gives $\sigma_b = 19.5$ dynes/cm. as a "universal" value. This is only approximately true, and many substances such as CO_2 and H_2O deviate widely.

The many simplifying assumptions by which Eq. (7) was reduced to this final σ_b value would be expected to decrease the accuracy considerably, of course.

Method 1c—Best of All

Another property, similar to parachor and also nearly temperature independent, is the molar refraction, [R], defined by the Lorentz-Lorenz expression:

$$[R_\lambda] = \frac{M}{\rho_l}\left(\frac{n_\lambda^2 - 1}{n_\lambda^2 + 2}\right) \qquad (12)$$

where λ = wavelength of the light used in the refractive index determination.

Since it's customary to use the D line of sodium as the standard basis, molar refraction is usually denoted by $[R_D]$. Additive values for $[R_D]$ were given earlier in this series.[3]

If Eq. (6) with ρ_v omitted is divided by Eq. (12), we obtain:

$$\sigma = \left[\frac{[P](n^2 - 1)}{[R_D](n^2 + 2)}\right]^4 \qquad (13)$$

a form which Tripathi,[21] Meissner and Michaels,[22] and Kharbarda[23] all found slightly superior to Eq. (8). Kharbarda's convenient nomograph is given here as Fig. 3.

Meissner and Michaels found an average error for 47 pure organics

Atomic Volumes at the Normal Boiling Point—Table I

As	30.5	F	8.7	I	37.0	Si	32.0
Bi	48.0	Ge	34.5	P	27.0	Sn	42.3
Br	27.0	H	3.7	Pb	48.3	Ti	35.7
C	14.8	Hg	19.0	S	25.6	V	32.0
Cr	27.4					Zn	20.4

Cl, terminal, as in RCl	21.6	in higher esters, ethers	11.0
medial, as in R–CHCl–R	24.6	in acids	12.0
Nitrogen, double-bonded	15.6	in union with S, P, N	8.3
triply bonded, as in nitriles	16.2[a]	3-membered ring, deduct	6.0
in primary amines, RNH_2	10.5	4-membered ring, deduct	8.5
in secondary amines, R_2NH	12.0	5-membered ring, deduct	11.5
in tertiary amines, R_3N	10.8[b]	6-membered ring as in benzene, cyclohexane, pyridine, deduct	15.0
Oxygen, except as noted below	7.4	Naphthalene ring, deduct	30.0
in methyl esters	9.1	Anthracene ring, deduct	47.5
in methyl ethers	9.9		

a—Determined by author from available data.
b—Determined by author from very limited data.

at 20 C. of plus or minus 2.8%, Tripathi found a 1% average deviation for five liquids at 20 C., and Kharbarda's comparisons give a 1.8% error for eight organics at 20 or 25 C. It would appear, then, that an average error of plus or minus 2.5% would be expected at about 20 C.

Since there is no vapor density term in it, use of Eq. (13) should be limited to temperatures considerably below the critical.

Eq. (13) is somewhat superior to Eq. (8) for two reasons: First, refractive index can be determined faster and more accurately, generally, than liquid density; and second, errors in [P] and [R_D] frequently tend to compensate when quantities are in ratio form.

Meissner and Michaels[22] recommend the use of Sugden's original additive contributions[14] for [P], rather than those of Mumford and Phillips which are best for Eqs. (7) and (8). Sugden's values for use in Eq. (13) only are given here in Table II.

It's fairly interesting to note that refractive index, n, can be roughly estimated by solving Eq. (12) for n:

$$n = \left(\frac{2[R_D] + V}{V - [R_D]} \right)^{0.5} \qquad (14)$$

where V is the molar liquid volume.

Method 2—Buehler's Relation

Buehler[24] drew attention to a relation between surface tension and viscosity that applies to a wide range of organic liquids:

$$\sigma = \left[\frac{\log (\log \mu) + 2.9}{I/[P]} \right] \qquad (15)$$

The symbol I denotes the "viscosity-constitutional constant" proposed by Souders[25] in connection with an equation for estimating liquid viscosity.

The constant I, like [P], is additive, nearly temperature-independent and constitutive. I may be evaluated by summing the contributions given in Table III. Alternatively, molar refraction [R_D] may be calculated and I then found from Lagemann's nomograph,[26] reproduced here as Fig. 4.

This writer has found that I values from the nomograph usually checked—when used in Eq. (15)—better than those computed from the table. The error in I appears to increase with halogen substituents and with accumulation of negative groups, especially if they are attached to adjacent carbon atoms.

Sugden's Parachor—Table II

C	4.8
H (to O)	11.3
H (to C)	17.1
O (hydroxyl, ether)	20.0
O (carboxyl)	43.2[a]
O_2 (in esters, acids)	60.0
F	25.7
Cl	54.3
Br	68.0
I	91.0
N (all amines)	12.5
N (nitrile)	29.1[b]
S	48.2
P	37.7
3-membered ring	16.7
4-membered ring	11.6
5-membered ring	8.5
6-membered ring	6.1
Double bond	23.2
Semipolar bond, deduct	21.6
Triple bond	46.6

a—Including double bond allowance.
b—Including triple bond allowance.

Kharbarda's Convenient Chart Estimates Surface Tension Quickly

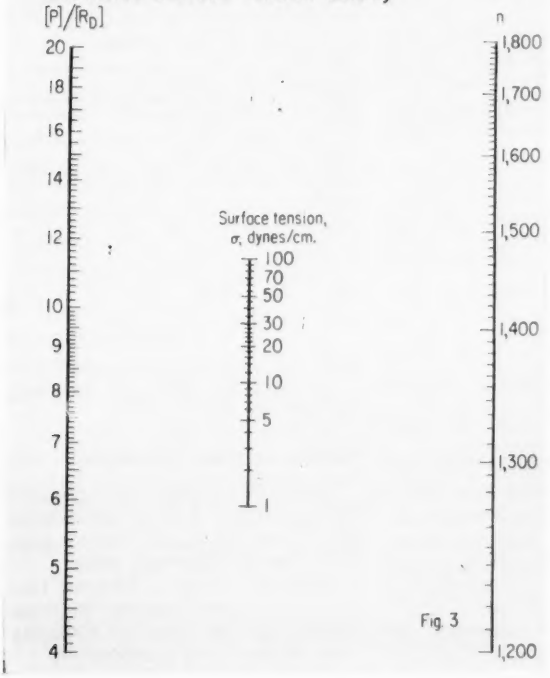


Fig. 3

Lagemann's Nomograph Speeds the Use of Souders' Equation

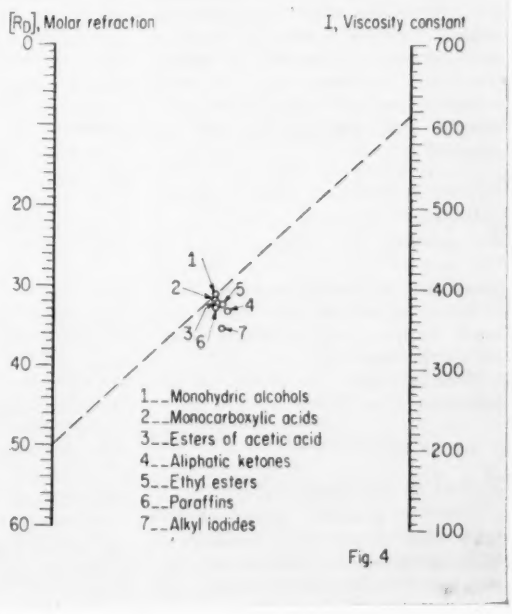
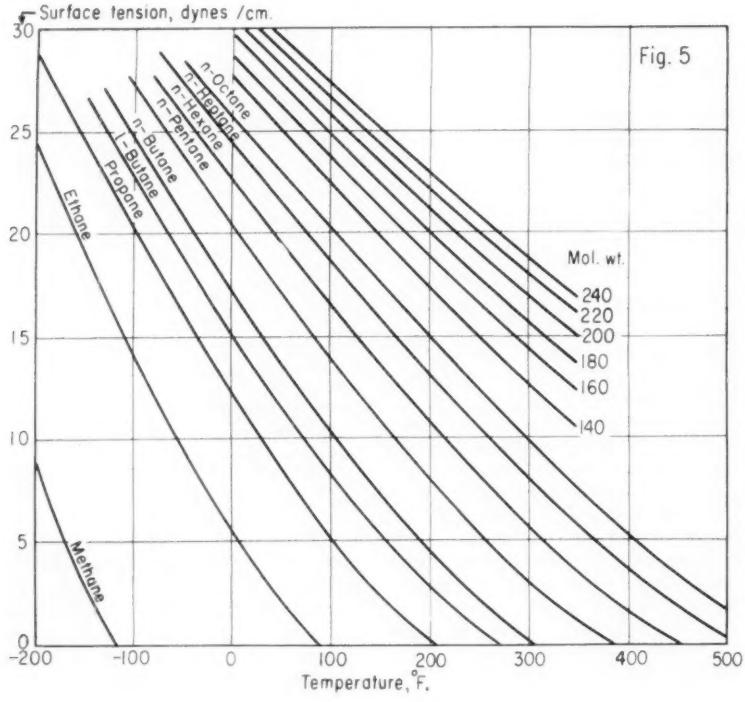


Fig. 4

For Paraffins, You Can Use This Chart



Viscosity Constitutional Constants—Table III

Atomic, Group Values	
CH_2	55.6
H	2.7
C	50.2
O	29.7
OH	57.1
COO	90
COOH	104.4
NO_2	80
N	37
Cl	60
Br	79
I	110
Structural Values (R = hydrocarbon X = a negative group)	
CR_4	13
RCHO	10[a]
$RCOCH_3$	5
R_2CHX	6
$R_2(CH)_2R_2$	8
$-CH=CHCH_2X$	4
Double bond	−15.5
5-C ring	−24
6-C ring	−21
Side group on 6-C ring:	
MW of group less than 17	− 9
MW of group more than 16	−17
Ortho and para	3
Meta	1

a—Value originally given as 16, but M. Souders in a personal communication to A. Boas, stated that it should be 10.

In these two cases, calculated I values are greater than those observed. For 32 pure organic liquids, Buehler found that the best average value of $I/[P]$ is, within about plus or minus 6%, 1.22. The range was 1.16 to 1.30; the larger values being for compounds with larger carbon chains. Buehler excluded, however, consideration of substances whose parachors increase slightly with temperature (alcohols, amines, carboxylic acid and phenols, for example).

Method 3—Walden's Rule

Walden[27] proposed a simple rule for estimating surface tension at the normal boiling point. The rule correlates data for a dozen compounds, for which this writer has made comparisons, to within about plus or minus 5%.

Walden's rule is given as follows:

$$\sigma_b = ML_V\rho_{Lb}/3.64 \qquad (16)$$

Method 4—Use Specific Data

There is available a nomograph that gives the surface tensions of 102 liquids as a function of temperature.[28] This nomograph was published by Othmer and coworkers and space does not permit us to reproduce it in its entirety. Therefore, we refer you to the original reference.

For paraffin hydrocarbons only, we recommend the chart given above as Fig. 5. This chart was prepared by George Granger Brown for the Natural Gasoline Supply Men's Assn.[29]

REFERENCES

1. Weissberger, A., "Physical Methods for Organic Chemistry," Vol. 1, p. 163, Interscience, New York (1945).
2. Tamamuski, *Bull. Chem. Soc. Japan*, **1**, p. 173 (1926).
3. Gambill, W. R., *Chem. Eng.*, July 1957, p. 266.
4. Eötvos, *Ann. Phys.*, **27**, p. 448 (1886).
5. Ramsay-Shields, *Phil. Trans*, **184**, p. 647 (1893).
6. Glasstone, "Textbook of Physical Chemistry," pp. 491-493, D. Van Nostrand, Princeton, N. J.
7. Katayama, M., *Sci. Repts. Tohoku Imp. Univ.*, **4**, p. 373 (1916); *J. Chem. Soc.*, **110, II**, p. 219 (1916).
8. Macleod, D. B., *Trans. Faraday Soc.*, **19**, p. 38 (1923).
9. Sugden, S., *J. Chem. Soc.*, **125**, p. 1,177 (1924).
10. Ferguson, A., *Trans. Faraday Soc.*, **19**, pp. 41, 407 (1923).
11. Fowler, R. H., *Proc. Royal Soc. (London)*, **A159**, p. 229 (1937).
12. "A List of Parachors," *Brit. Assn. Advancement Sci. Rept. No. 265* (1932).
13. Quayle, O. R., *Chem. Reviews*, **53**, No. 3, Dec. 1953.
14. Sugden, S., "The Parachor & Valency," G. Routledge & Sons, Ltd., London (1930).
15. Reilly & Rae, "Physico-Chemical Methods," 3rd Ed., pp. 109-113, D. Van Nostrand, Princeton, N. J. (1939).
16. Thomson, G. W., pp. 202-208 of Ref. 1, above.
17. Gibling, T. W., *J. Chem. Soc.*, pp. 299, 304 (1941); pp. 661, 665 (1942); pp. 380, 383 (1944); p. 236 (1945); and pp. 146, 149 (1953).
18. Plank, R., *Kälteechnik*, **6**, p. 59 (1954).
19. Johnson, A. I., et al., *Chem. in Canada*, Aug. 1954, p. 28.
20. Le Bas, G., "Molecular Volumes of Liquid Chemical Compounds," Longmans, Green & Co., (1915).
21. Tripathi, R. C., *J. Indian Chem. Soc.*, **18**, pp. 411-414 (1941).
22. Meissner, H. P., and A. S. Michaels, *Ind. & Eng. Chem.*, **41**, pp. 2,782-2,787 (1949).
23. Kharbarda, O. P., The Ind. Chemist, April 1955, pp. 187-192.
24. Buehler, C. A., *J. Phys. Chem.*, **42**, pp. 1207-1,209 (1938).
25. Souders, H., *JACS*, **60**, p. 154 (1938).
26. Lagemann, R. T., *Ind. & Eng. Chem.*, **37**, p. 600 (1945); *JACS*, **67**, p. 498 (1945); also, Lagemann & Dunbar, *J. Phys. Chem.* **49**, p. 428 (1945).
27. Walden, Z. *Elektrochem.*, **14**, p. 712 (1908).
28. Othmer, D. F., et al., *Ind. & Eng. Chem.*, **40**, p. 886 (1948).
29. Natural Gasoline Supply Men's Data Book, 7th Ed. (1957).

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C. H. LI, Radio Corporation of America, Harrison, N. J.*

Practically all engineers and scientists have to run experiments.

When these experiments involve only two or three factors or variables, they are easily dealt with, although the methods and efficiencies of experimentation vary.

In the "trial and error" or "shot-gun" method, the experimenter selects and makes a few random tests, hoping to hit the best conditions. This method depends very much on intuition and luck. It is not reliable and seldom gives the best results.

The classical method of experimentation involves keeping all factors except one constant, and determining the best condition for this tested factor. The condition for the first factor is then used throughout later tests to find the best conditions for other factors, one at a time. Major disadvantages of this method are: it is inefficient; and it requires as many series of tests as the number of factors under test, which may be very time-consuming.

When an orthodox statistical method is used, a statistician chooses a proper design to test either all possible combinations of the factors, or a systematic fraction of these possible combinations. This method not only finds the effect of all factors, but reveals any possible interactions† between factors. It is generally very efficient.

There are some disadvantages, however, to some statistical techniques.

Number of tests become too large when many factors are to be studied: either a statistician is needed or the engineer has to be thoroughly trained on this method; a machine calculator is indispensible; and the careful planning and execution of the experiment, as well as the involved analysis of test results cause delays. These delays are often intolerable.

Box Method Advantages

Recently, a new method of experimentation has been developed, called the Box (or Box-Wilson) method, after the originator G.E.P. Box. It is dynamic, flexible, and yet very efficient.

In this method a series of small experiments are set up so related that results of previous tests are fully used, yet without loss of efficiency common with short-run tests. It has been successful in chemical and other industries.

In principle, the Box method is identical to the familiar scientific method of experimentation, only it is made more systematic by applied statistics. Actually statistical factorial experimental design is an integral part of the method.

As usual, the experimenter sets up and makes some tests, analyzes the results, and makes some more tests, and so on. But the experimenter uses known techniques of good experimental planning and data analysis, foresees any possible outcomes of the tests, and plans his first experiments with an eye on the last. Each test result is used not just once, but many times to get better means, more accurate average effects, or more reliable conclusions.

Using the Worksheet

We have developed a worksheet which uses this Box method for finding optimum conditions.

It is designed for engineers or foremen who may not have an extensive background in statistics. The procedure for use is given in a cook-book fashion. Caution should, of course, be exercised, and Ref. 1 pp. 495-578, 263-5 should be looked at.

Where To Use Sheet

When conditions are suitable, the worksheet may be used in the following cases:

- Trouble-shooting on an urgent research or production problem where quick results and immediate actions are needed.
- Developing a new allow or composition by finding the effect of all ingredients and their best combinations.
- Designing the proper types of components including their dimensions for best performance of

* Meet your author on page 181.

† If the effect of one factor is different at different levels of another factor, these factors interact (pressure at two temperature levels).

Here, Chart Is Used to Find Best High-Strength Alloy

Experiment: Special Iron Base Alloy Object: Max hot strength Data: Tensile strength 1000 psi Date:

Error of single test ≤ 0.24
$e = 2.43 \times$ smallest effect
Error, effect $= e\sqrt{2/8} = 0.354\,e$

$I = ABCD = -BCE = -ADE = -ACF = -BDF = -ABG$
Interaction of factors

Line	Factors studied		A	B	C	D	E	F	G	H	J	K	L	M	N
1										Data	Calculation			Effect of Each Factor	
2			Cr	Ni	Mo	V	Nb	Mn	C						
3	Base level		4%	2%	0.1%	0.02%	0.1%	0.4%	0.4%						
4	Unit		1	1	0.1	0.02	0.1	0.1	0.1						
5	High level		5	3	0.2	0.04	0.2	0.5	0.5						
6	Low level		3	1	0	0	0	0.3	0.3						
7	Sample 1	Test 5	3	1	0	0	0	0.3	0.3	1.5	5.0	14.4	35.9	4.49	Average
8	2	8	5	3	0	0	0.2	0.5	0.3	3.5	9.4	21.5	0.7	-0.09	B
9	3	1	5	1	0.2	0	0.2	0.3	0.3	6.2	10.4	-1.0	5.1	0.64	C
10	4	3	3	3	0.2	0	0	0.5	0.5	3.2	11.1	0.7	-4.3	-0.54	BC = AD = -E
11	5	4	5	1	0	0.04	0	0.5	0.5	5.3	2.0	4.4	7.1	0.89	ABC = D
12	6	6	3	3	0	0.04	0.2	0.3	0.5	5.1	-3.0	0.7	1.3	0.16	AC = BD = -F
13	7	2	3	1	0.2	0.04	0.2	0.5	0.3	5.3	-0.2	-5.0	-3.7	-0.46	AB = CD = -G
14	8	7	5	3	0.2	0.04	0	0.3	0.3	5.8	0.5	0.7	5.7	0.71	A
15	Effect		0.71	-0.09	0.064	0.89	0.054	-0.16	0.46						
16	Effect times unit		0.71	-0.09	0.064	0.018	0.054	-0.016	0.046						
17	Change		0.8	-0.1	0.07	0.02	0.06	-0.02	0.05						
18	Best path		4.8	1.7	0.17	0.04	0.16	0.38	0.45						
19			5.6	1.8	0.24	0.06	0.22	0.34	0.50						
20			6.4	1.7	0.31	0.08	0.28	0.34	0.55						
21			7.2	1.6	0.38	0.10	0.34	0.32	0.60						
22	Trial 9		8.0	1.5	0.45	0.12	0.40	0.30	0.65	10.3					
23			8.8	1.4	0.52	0.14	0.46	0.28	0.70						
24	Trial 10		9.6	1.3	0.59	0.16	0.52	0.26	0.75	11.0					
25	Trial 11		10.4	1.2	0.66	0.18	0.58	0.24	0.80	11.5					
26	Trial 12		11.2	1.1	0.73	0.20	0.64	0.22	0.85	11.2					
27	Trial 13		12.0	1.0	0.81	0.22	0.70	0.20	0.90	10.1					

Conclusions:

Best composition (trial 11)

Cr	10.4%
Ni	1.2%
Mo	0.66%
V	0.18%
Nb	0.58%
Mn	0.24%
C	0.80%

Expected tensile strength:
11,500 ± 240 psi

a given mechanical or electrical device.

• Improving a production process on yield, cost, or product quality.

• Scanning a great number of factors or controllable variables for the most important few to be closely studied.

• Setting-up the first runner of a possibly large project, to be effectively supplemented by future tests when needed.

The worksheet is self-contained. All the response and control variables, details of data analysis, precision of tests, and other important conclusions are given on a single page.

It applies the Yates method of data analysis. Calculations are simple enough so an engineer or foreman can do them in a few minutes, without machine calculators. The Yates method is a systematic tabular technique for evaluating the effect of four or more factors.

Up to seven factors can be tested with a single worksheet. Fewer factors should be selected, however, if they interact.

It uses the Box method for examining response surfaces‡ and following the steepest ascent line to the optimum point.

Only four or eight tests are needed to establish the response contours and to find the effect of various factors. These tests may be followed by a few more tests to reach the maximum point.

The worksheet may be used in a sequential manner. A group of four tests may first be run to study up to three factors. A second group of four more tests may, if desired, next be made, not only to study up to four more factors, but also to improve the conclusions from the first group of tests. Response surfaces may be examined and the steepest ascent method applied for each or both of the two groups of four tests (or confirmation experiment in which the same factors are assigned to different columns on the worksheet). Contradictory results from the two experiments may reveal interactions.

The response surfaces are usually not too complicated. Most response surfaces known for actual systems have one or two maximum peaks, and the response contours are not difficult to establish. If complex response surfaces do exist in the small experimental region, erroneous conclusions may be drawn. The possibility of reaching wrong conclusions, however, is ever present with any method of experimentation when the system of factors is complex. Here again,

†† Just as the relationship between y and a single factor x can be represented by a curve, the relationship between y and a number of variables can be shown with a surface, called a response surface.

Same Chart Gives Process Conditions for Low Rejects

Line — Experiment: Increasing yield S.N. Object: Minimum rejects Data: Tentative Date:

	Factors studied		A	B	C	D	E	F	G
1			Preform temp	Cleaning	Reagent added	Additive	Press.	Voltage	Time
3	Base level		150C	—	15.16	—	350	9	15 min
4	Unit		50	—	5	—	50	3	5
5	High level		200	yes	20	#2	+00	12	20
6	Low level		100	no	10	#1	300	6	10
7	Sample 1	Test #	100	no	10	#1	350	6	15
8	2	2	200	yes	10	#1	350	12	15
9	3	1	200	no	20	#1	350	6	15
10	4	3	100	yes	20	#1	350	12	15
11	5	4	200	no	10	#2	300	12	20
12	6	6	100	yes	10	#2	400	6	20
13	7	5	100	no	20	#2	400	12	10
14	8	7	200	yes	20	#2	300	6	10
15	Effect		-2.5	-1.5	-1.0	-0.6	-3.7	-1.3	-0.2
16	Effect times unit		-75	—	-0.5	—	185	3.9	-1.0
17	Change		25	—	1.7	—	62	1.3	0.3
18	Best path		175	yes	16.7	#2	412	10.3	15.3
19			200	yes	18.4	#2	474	11.6	15.6
20	Trial 9		225	yes	20.1	#2	536	12.9	15.9
21	10		250	yes	21.8	#2	598	14.2	16.2
22	11		275	yes	23.5	#2	660	15.5	16.5
23	12		300	yes	25.2	#2	722	16.8	16.8
24			325	yes	26.9	#2	784	18.1	17.1
25									
26									
27									

Error of single test $e \approx 0.24$
$e = 2.43 \times$ smallest effect
Error, effect $= e^2/8$
$= 0.354\,e$

$I = ABCD$
$= -BCE = -ADE$
$= -ACF = -BDF$
$= -ABG$
Interaction of factors

H	J	K	L	M	N
Data	Calculation			Effect of Each Factor	
12	16	28	Average	7.0	Average
4	12	-6	B	-1.5	B
5	-8	-4	C	-1.0	C
7	2	10	-A	2.5	BC = AD = -E
8	13	23	Average	5.8	ABC = D
5	10	-1	B-F	-0.2	AC = BD = -F
4	-3	-3	C-G	-0.8	AB = CD = -G
6	2	5	A-E	1.2	A

Conclusions:

Effects: $D = (5.8 - 7.0)/2 = -0.6$
$E = A - 1.2 = -3.7$
$F = B + 0.2 = -1.3$
$G = C + 0.8 = -0.2$

Best combination (Trial 11)
Preform temp. 275C
Cleaning yes
Reagent added 23.5 lb
Additive #2
Pressure 660 psi
Voltage 15.5 v
Treat time 16.5 min

special confirmation tests may be needed.

Assumptions in Design

Design of the worksheet is not complicated. The eight treatment or factor combinations (one for each sample) are selected from an orthodox statistical design given in Table 10A.1 on p. 485 of Ref. 1. Technically, it is called a $\frac{1}{16}$-replicate of a seven-factor design, each factor having two levels or conditions tested (see charts).

Note that eight combinations are arranged for data analysis either simultaneously on all eight test results, or separately on the first or second group of four test data.

Effects of various factors, as found by the Yates method, are used to locate the steepest ascent line and to find the maximum point by a few more tests. This section is on the bottom-half of the sheet.

A number of assumptions were made in design of the worksheet.

First, precision of tests or experimental error is small. If the error is not small, tests may have to be repeated. Each sample number then becomes a sample group number.

Data or test results are normally distributed. However, abnormal data may be transferred into normal data. If the tests are repeated, particularly if repeated a number of times, the averages from any data become nearly normal.

When four or more factors are tested with a single worksheet, it is assumed that interactions among these factors either are absent or are very small. This assumption is generally true.

If interactions exist, fewer factors should be put in each experiment. For example, if three factors are tested all main effects and interactions can be estimated; whereas if four factors are tested with the same number of samples, only one pre-specified interaction is lost.

Let's Work Examples

The use of the worksheet is best illustrated by analysis of the following two hypothetical examples. (1) find the best composition of an alloy for a special use; (2) optimize a certain process for minimum "scrap" or cost.

Example 1: Develop an alloy design for very high hot strength. For this particular use, cost considerations indicate that an iron-base material is desirable. Additions of various elements will be made to achieve the desired properties, including chromium, nickel, molybdenum, vanadium, niobium, manganese, and carbon.

The following steps are involved in the procedure (see chart):

1. Name and object of the experiment are first entered, together with the data to be taken and the date.

2. Elements, the amounts of which will be varied, are entered as factors A to G. Metallurgical and economic considerations determine the base levels and units or variation for some elements. For the other elements, these values are estimated. The high levels (shaded in the worksheet) are obtained by adding the units of variation to the respective base levels, and the low levels by subtracting the units of variation from the base levels.

3. Because the number of factors in this problem is seven, eight tests must be made. The number of tests must be at least one greater than the number of factors.

4. Order of test is determined by the random drawing of eight numbered chips and the recording of the numbers drawn in sequence. If chip 3 is drawn first, for example, test 1 is to be made on sample 3.

5. Each sample is composed of high- or low-level amounts of the various elements, as indicated by the presence or absence of black in the worksheet. Sample 1, for instance, has low levels of all elements. Sample 2 has high levels of chromium, nickel, niobium, and manganese, but low levels of molybdenum, vanadium, and carbon. To fill in this information on the composition of the different samples, it is convenient to work through each element or column at a time, filling in the four shaded spaces on the worksheet with the high-level conditions, and then the remainder with the four low-level conditions.

6. Samples are prepared by special melting and mechanical working in the assigned order. They are then tested for the desired propery—tensile strength at 800 C. Test data are entered in column H.

7. Results of the eights tests are analyzed by the Yates method. First, the results are divided into four consecutive pairs. The two numbers in each pair are then added together to give the first four figures in the J column (1.5 + 3.5 = 5.0; 6.2 + 3.2 = 9.4; 5.3 + 5.1 = 10.4; 5.3 + 5.8 = 11.1). And the first number of each pair is subtracted from the second to give the last four figures in the J column (3.5 − 1.5 = 2.0; 3.2 − 6.2 = −3.0; 5.1 − 5.3 = −0.2; 5.8 − 5.3 = 0.5). These processes are repeated on column J to obtain the values for column K, and repeated on column K to obtain column L. The values in column L are then divided by the number of tests (i.e., 8) to yield the figures for the "effects" column, M. The effects are identified by letter symbols in the last column, N.

8. Effects listed in columns M and identified in column N are entered in line 15, with caution as to signs (plus or minus) and positions (A to G).

9. Preliminary conclusions are first, the average tensile strength at 800 C. for the eight samples is 4,490 psi. This value is the expected hot strength of a sample having all alloy additions at the base levels, i.e., 4% Cr, 2% Ni, 0.1% Mo, 0.02% V, 0.1% Nb, 0.4% Mn, and 0.4% C.

Second, vanadium appears to have the greatest effect, increasing the hot strength by 890 psi. for each 0.02% added. In other words, each 0.1% of vanadium added raises the hot strength by 4,450 psi.

Chromium, molybdenum, niobium, and carbon increase the hot strength by 71, 640, 540, and 460 psi., respectively, for each 0.1% of alloy addition. Manganese and nickel, however, probably have little or slightly negative effects on the hot strength.

Probable error of a single test is estimated by examination of the smallest effects, in this case 0.09 or 90 psi. due to addition of nickel and 0.16 or 160 psi. due to manganese. For this problem, the error is of the order of 240 [90 $(8)^{1/2}$] psi. (if nickel has no effect at all) or less.

The Box method of "steepest ascent" may now be applied if desired. In this method, a few additional tests located on the line of expected maximum response are selected, and the following extra steps are taken:

10. Effects in line 15 are multiplied by the respective units of variation in line 4, giving line 16. If it is desired to change the unit of variation for one of the elements to a more convenient amount (chromium, for example, may be varied in the additional tests by 0.8% rather than the odd number 0.71%), all the values in line 16 must be changed proportionately by the same factor (e.g., 0.8/0.71 = 1.13) to yield line 17.

11. The best path is then determined by successive additions of the proposed changes in line 17 to the corresponding base levels in line 3. Thus, line 18 = line 3 + line 17; line 19 = line 3 + (2 x line 17); line 20 = line 3 + (3 x line 17); and so on.

12. An extra melt is made according to the composition given in line 22, which is considerably different from the base-level conditions. Because of the encouraging result of 10,300 psi., melt 10 (line 24) is made, followed in order by melts 11, 12, and 13 (line 25, 26, and 27). The results of hot-strength tests on all these additional melts are entered in column H.

13. By inspection, it is seen that the maximum hot strength is reached on melt 11. Consequently, the best composition is as follows: 10.4% Cr, 1.2% Ni, 0.66% Mo, 0.18% V, 0.58% Nb, 0.24% Mn, and 0.80% C. The expected hot strength of this combination is 11,500 ± 240 psi.

Sequential Example

Example 2: Processing design for minimum rejects. A number of processing factors are likely to affect rejects of a certain product. Some of these factors are listed below, together with the suggested low- and high-level conditions:

Factor A: Prefire temperature —100 vs. 200 C.

Factor B: Special cleaning—no cleaning vs. cleaning.

Factor C: Amount of reagent added—10 vs. 20 pounds.

Factor D: Special additive—Additive #1 vs. #2.

Factor E: Applied pressure on a certain equipment—300 vs. 400 lb.

Factor F: Applied voltage on another equipment—6 vs. 12 volts.

Factor G: Treatment time—10 vs. 20 minutes.

The experimental design may be as follows: At first, four tests are made on samples 1 to 4, in the random order 4, 2, 1, 3.

Factors A, B, and C are varied, other factors being kept constant: D at the low level; E, F, and G at the base levels, in order to fully use the worksheet. The data analysis is similar to that in Example

Steepest Ascent Method Best for Obtaining Optimum Conditions

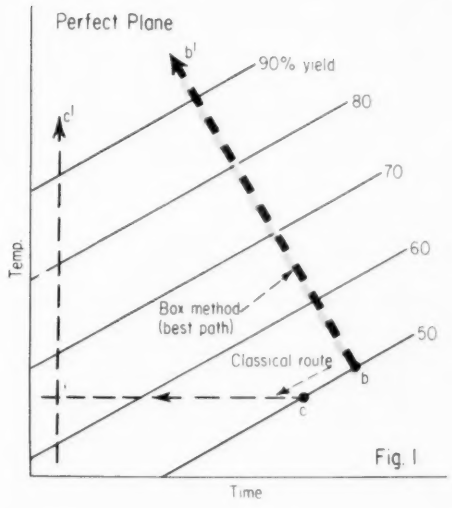


Fig. 1

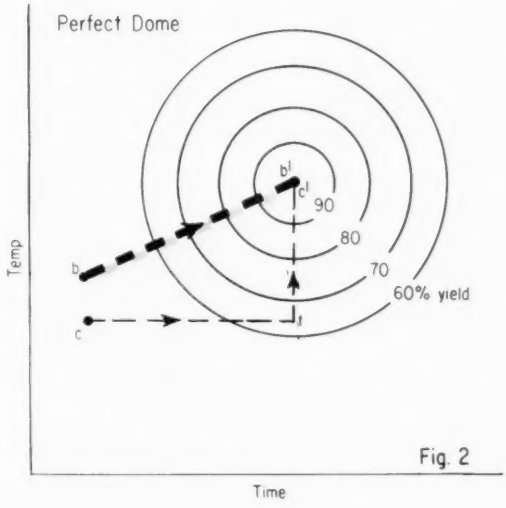


Fig. 2

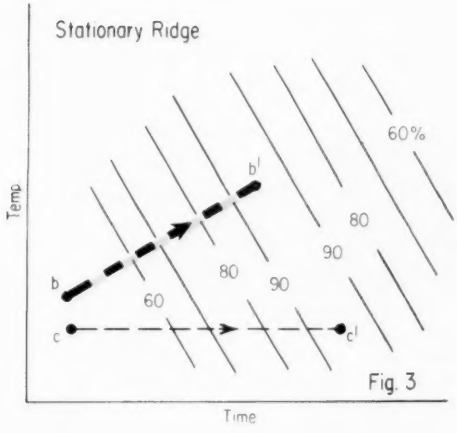


Fig. 3

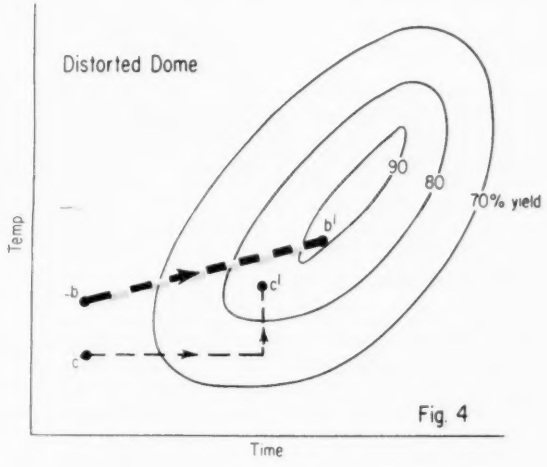


Fig. 4

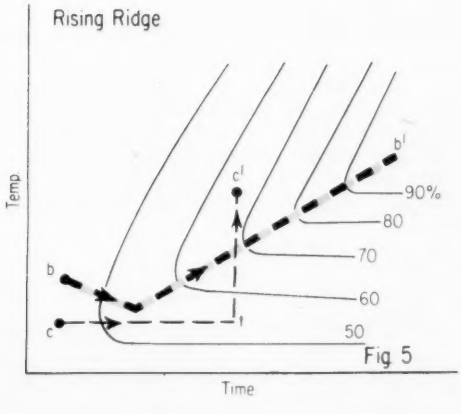


Fig. 5

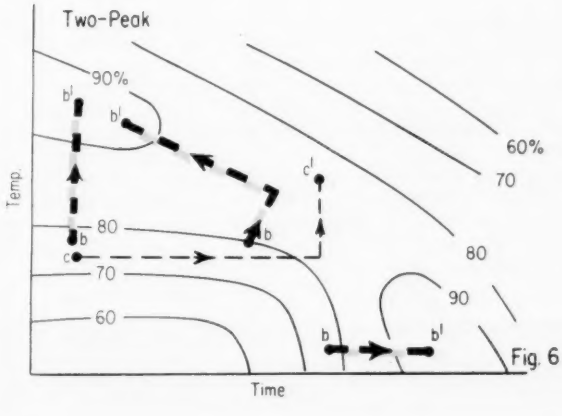


Fig. 6

1, except that only two, instead of three, cycles of arithmetic operations are involved, each on four figures, rather than eight. The average effects found are A = −2.5; B = −1.5; and C = −1.0. The negative signs indicate that these factors all tend to reduce the scrap figure, factor A being the most effective.

The above conclusions may be used as such. However, it may be decided to introduce the four additional factors D, E, F, and G. Only four more tests are next made on samples 5 to 8. The average effect of these additional factors can be found as shown.

Finally, the method of steepest descent can be applied if needed.

As shown on the sheet, four trials were attempted on the path of steepest ascent. Trial 11 resulted in zero rejects. Final or best combination for the process: prefire temp., 275 C.; cleaning preferred; reagent added, 23.5 lb.; additive no. 2; pressure, 660 psi.; voltage, 15.5 v.; treat time, 16.5 min.

Actually this is an approximation of the best combination, good enough for most situations. Techniques are available for obtaining a more accurate "best" combination, calling for additional experiments.

More On Box Method

Plant managers and project engineers should like the Box method we discussed because it gives useful conclusions from the very first few tests made. The tests can therefore, be stopped at any moment, such as when facilities on the project are suddenly curtailed. Yet more tests can also be efficiently added as complexities or the needs for details arise.

We will not attempt to go into the mathematical derivations for this method. It is strongly suggested that you read Ref. 1 for a practical treatment of optimizing methods.

We will give some important highlights which should give you an idea of what is involved and where this technique can be used to advantage.

Response Surfaces

A useful concept brought in by the Box method is the response surface. Engineers have always been dreaming of showing the desired changes on the response variables, such as yield, quality, and cost, in spatial relationship with the various factors. By the use of the Box method, these response surfaces can be established, with but a few tests.

Only response surfaces for two factors are shown here. A common way of showing these response surfaces in graphical form is to draw lines of equal responses on these surfaces. These lines or response contours are like similar lines on weather or topography maps. Some typical examples of response surfaces are shown in the following figures, which also compare the Box method with the classical one-factor method of experimentation under the various conditions (see p. 155).

All these figures show the variation of yield with temperature and time. Yield is the response variable, while temperature and time are the factors or control variables.

Fig. 1 shows a case where the response surface for yields is a perfect plane. Response contours or lines of equal yields are therefore parallel, straight lines.

The classical experimenter would probably start testing at point c by varying the time but keeping temperature constant. A first series of constant-temperature tests along line c-t locates the temporary maximum point t.

Maximum point c' is reached after a second series of constant-time tests along line t-c'. The experimenter using the Box method would set up four tests around starting point b, and add a few more tests on the steepest ascent line b-b'. Both experimenters would reach the same maximum yield. The classical experimenter, however, must make more tests to reach the same goal.

When the response surface is dome-shaped, the response contours may be concentric circles. Such a case is shown in Fig. 2. In Fig. 3, the response surface is a stationary ridge, the yield being maximum on the inclined ridge line and decreasing as the distance from this ridge line increases. The same notes given in Fig. 1 apply in both cases shown by Figs. 2 and 3.

Fig. 4 shows a situation where the response contours are a series of ellipses. In this case, the classical experimenter may make many tests without reaching the maximum yields.

The response contours shown in Fig. 5 are for a response surface of the rising-ridge type. Here again, the classical experimenter may miss the maximum yields. Using the Box method, you locate a temporary maximum point from which the true maximum yield b' is reached by tests along the new steepest ascent line.

Fig. 6 shows a case where the response surface has two regions of maximum yields. In this instance, the classical experimenter may miss both of them. The Box method insures reaching either or both of them no matter where the tests are started.

What Can Method Do?

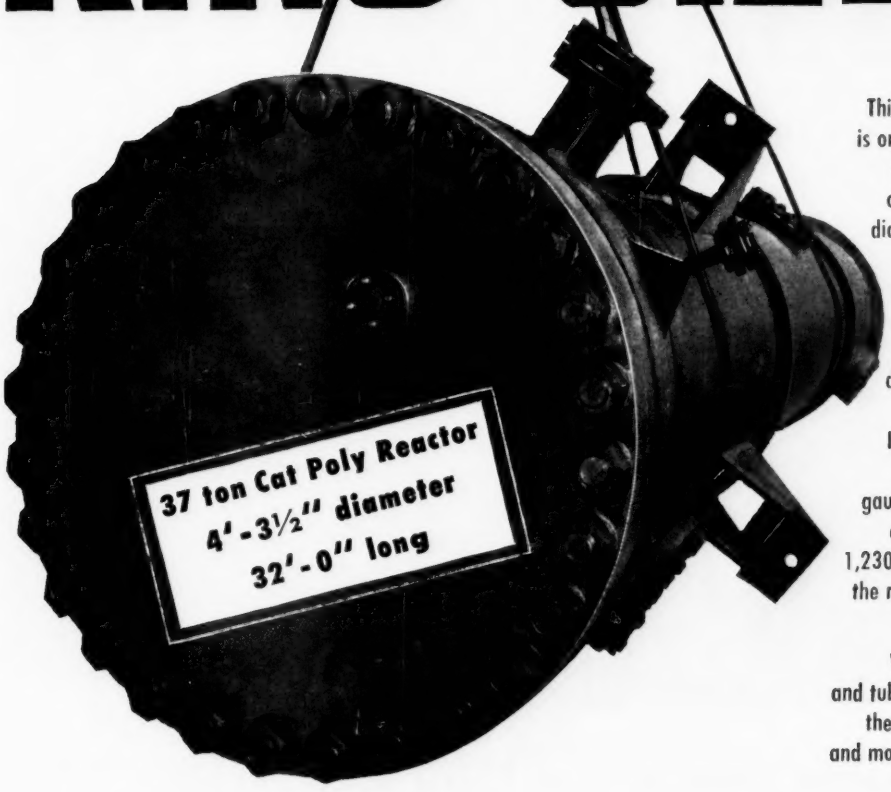
In summary, the Box method consists of:

- Running a few selected tests around a chosen point within the experimental region.
- Analyzing the test results to find effects of the various factors.
- Establishing from the same results the response surface and contours in and near the tested area.
- Marking the line from the chosen experimental center to climb the response surface at maximum rate. This line is at right angles to all response contours crossed, and is therefore called the line of steepest ascent.
- Making some more tests along this line to reach the maximum point on the response surface. This step ends the first cycle of experimentation by the Box method.
- If desired, a second cycle may be started around this maximum as the new experimental center, to see if further improvement is possible. More accurate response contours may be established around this new center, and another line of steepest ascent drawn across these response contours, followed by actual tests selected on this line.

References

1. Davis, O. L., "Design and Analysis of Industrial Experiments," Hafner Publishing Co., N. Y., 1954.
2. Brownlee, K. A., "Industrial Experimentation," Chemical Publishing, N. Y., 1949.
3. Box, G.E.P. and K. B. Wilson, *Jour. of the Royal Statistical Society*, B. 13, 1951.

KING SIZE



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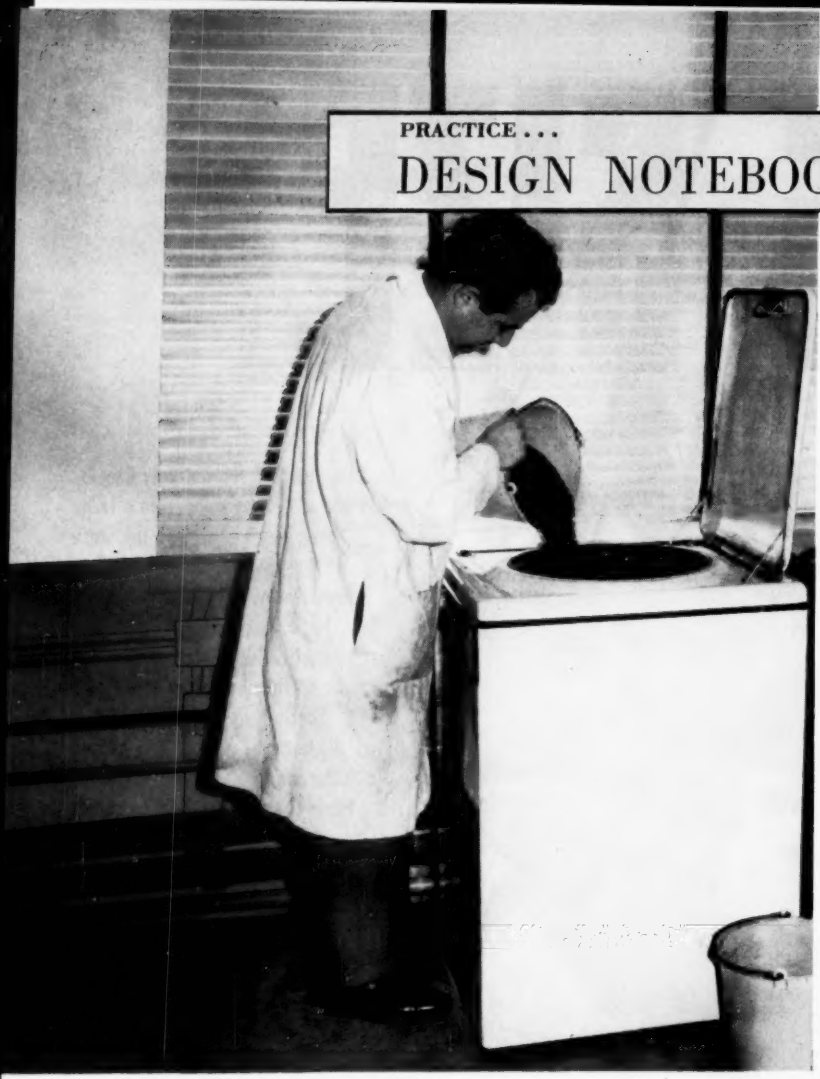

PRACTICE . . .

DESIGN NOTEBOOK

EDITED BY T. R. OLIVE

NEXT ISSUE:

See March Winner Announcement

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How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable non-winning articles will be published at space rates ($10 minimum).

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Design Notebooks, *Chemical Engineering*, 330 W. 42nd St., New York 36, N. Y.

Home Washer Doubles as Pilot Extractor

This pilot plant, needing a three-stage extraction, did the job with a washing machine at 1/40 of the budgeted cost.

★ February Contest Winner by Stanley Seltzer and Robert Paxton

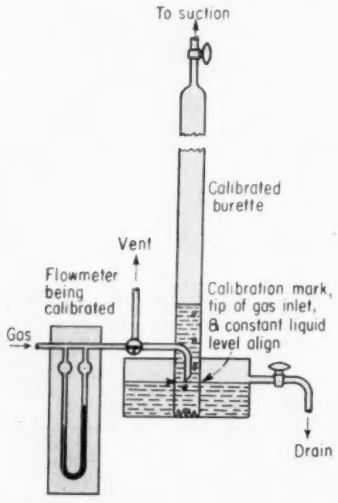
Chemical & Metallurgical Div., General Electric Co., Pittsfield, Mass.

Recently our pilot plant was faced with the problem of leaching soluble salts from a granular material. Bench experiments showed that a three-stage extraction would be ample. They also showed that the solvent was mildly corrosive to steel, and that a solvent concentration of 35% or less in the washed cake would be necessary to avoid an added process step.

A used automatic home washing machine with a vertical basket solved the problem handsomely. The up-and-down motion of the agitator promoted the leaching action during the "wash" and two "rinse" steps of the cycle. The spin-out after each step reduced the solvent concentration left in the cake to less than 35%. Indeed, the solvent removal ability of the 1,140-rpm., 20-in. solid basket compared favorably with that of conventional pilot-plant centrifugals.

The washing machine takes care of 6 lb. of cake on a 20 to 30-min. cycle. We provided a 50-mesh screen box at the outlet which collects about ½ lb. of solids per 6-lb. batch, keeping the over-all insoluble solids loss below 10%. The specific gravity difference between solvent and solid is 0.35-0.40 unit, and 75-80% of the washed recovered cake is retained on 40 mesh.

Using the washing machine meant less labor than a centrifugal. Its porcelainized interior showed no corrosion after four weeks of use, and our only difficulty came from overheating the drive motor if the load was too heavy, or the washing and filling parts of the cycle were greatly shortened. This seemed a small price to pay for plugging a process gap at 1/40th budgeted cost.



Quick Calibration for Small Gas Flowmeters

M. V. Kunte and M. U. Pai
National Chemical Laboratory
Poona, India.

Gas flowmeters for bench scale and small pilot-plant investigations are usually calibrated by means of secondary-standard meters or by direct determination by chemical or other means. The commonest secondary standard is the wet gas meter which, however, can not ordinarily be used with water soluble or corrosive gases. It is also rather expensive for use by a small laboratory, as well as subject to mechanical wear and tear, leading to leakage and associated troubles. Chemical absorption methods are time-consuming and require careful manipulation.

We have successfully adapted the common eudiometer to flowmeter calibration by some simple modifications as shown in the sketch. The apparatus is all-glass, consisting of an inverted calibrated burette connected at the top through a stopcock to a source of vacuum. A side-tube connects to the downstream side of the meter under calibration. The bottom of the burette, which is serrated to allow rapid liquid drainage, is liquid-sealed in a constant-level-overflow trough.

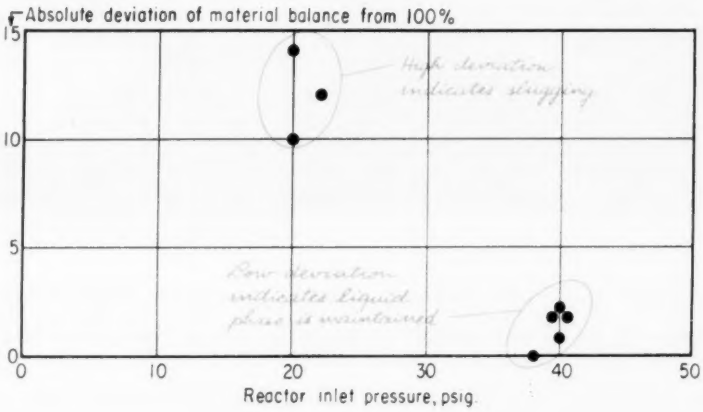
This is necessary to give a steady over-all pressure drop in the system throughout the calibration run.

The calibration mark on the burette, indicated by the triangle in the drawing, is aligned with the cut-off tip of the inlet tube and with the liquid level in the trough. This avoids the need for correcting the pressure of gas collected in the burette due to a variation in levels. However, the collecting pressure must be corrected to standard conditions for the vapor pressure of the seal liquid and the existing barometric pressure.

To use the apparatus to calibrate a flowmeter, first open the cock at the top of the burette to fill it completely with the seal liquid. Close the cock. Adjust the seal liquid level in the trough. Then, vent the flowmeter discharge through the side tube and adjust the gas flow rate to give the desired steady manometer reading. Finally, turn the vent stop cock to discharge the gas into the burette, carefully determining the time needed to discharge liquid from the burette down to the level of the calibration mark.

Various sizes of burette can be used to suit the desired gas flow rates. Any suitable sealing liquid can be used, depending on the properties of the gas. Such liquids include water, concentrated sulfuric acid, saturated, acidified salt solutions, etc.

In trials carried out in our laboratory this method has achieved results within 1 to 2% of those obtained by other methods, on gases such as air, carbon dioxide and chlorine. The system is inexpensive, it gives quick results and can be applied to many corrosive gases.



Material Balance Shows Homogeneous Flow

Gerald A. Lessells
Research Engineer, U.S. Industrial Chemicals Co., Cincinnati, Ohio

Once in a while the development engineer has the problem of translating a super-atmospheric, liquid-phase batch reaction into a continuous process carried out in a pipeline reactor. He may then run into difficulty in determining precisely what pressure will be needed to maintain a liquid phase in the reactor. The present article shows how this can be done.

Batch data are generally obtained in an autoclave where part of the volume is liquid-filled, the rest filled with vapor for safety reasons. In running a tubular reactor, however, it is best to maintain only a liquid phase to save reactor volume, and also to provide smooth flow, free from the slugging which might make control difficult.

There are several ways of estimating the minimum pressure needed to maintain the liquid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Launching Pad paved with Harbison-Walker Castable Refractory

phase, but all have drawbacks. One method is to assume that the needed pressure is the vapor pressure of the lowest boiling component at the reaction temperature. This will give an answer on the safe side but it may be far from accurate. Another way is to use Raoult's Law. This law assumes ideal liquid solution, which may or may not be the case. Even for ideal solutions this may not give a reliable estimate of the pressure owing to the continuous change in composition along the reactor due to the reaction. So, some empirical method seems to be called for to find the necessary information.

One qualitative empirical method is to place pressure gages at the reactor inlet and outlet, and possibly at a few other points along the reactor. Visual observation of the gages will show up flashing of the liquid in the reactor—if the pressure is too low—by erratic gage indication. Also, visual observation of the effluent stream—if it can be collected at atmospheric pressure —will indicate flashing in the reactor as an effluent stream pulsation.

Although these methods are useful, there is a far better and more quantitative method of demonstrating the required pressure. This is based on correlating the effect of reactor pressure and the material balance across the reactor. If the pressure is sufficient to maintain a liquid phase throughout the reactor, then the weight of material into the reactor will correlate well with the weight out measured during the same interval. But if the pressure is low enough to permit flashing of the reactor liquid, poor material balances will result due to slugging.

As an example, take the reaction of ethylene oxide with an excess of a high-boiling, active-hydrogen compound. Reaction is carried out in a tubular reactor consisting of 400 ft. of ¼-in. I.D. steel tubing immersed in a 170 F. oil bath. The reactants are stored under pressure and fed through rotameters and a mixing tee to the reactor. The ethylene oxide is reacted completely and the effluent, consisting of unreacted active-hydrogen compound, product and byproducts leaves through a pressure control valve and cooler to storage, to be distilled later.

If we should assume the necessary pressure as the vapor pressure of ethylene oxide, this would be 110 psig. Although this is not excessively high, we would prefer a pressure of less than 60 psig., since commercial ethylene oxide drums can be padded with nitrogen to about 60 psig.

We therefore ran experiments at two low reactor inlet pressures, at about 20 and about 40 psig. We took material balances by recording the ratio of weight of material in (as measured by flow rate through the rotameters), to weight out measured for the same time interval. Such balances are best taken over a time equal to the time in the reactor—in this case, a period of about 30 min.

For each run we calculated the material balance "closure" as a percentage, and from this the absolute deviation of the balance from 100%. When the absolute deviation for each run was plotted against the inlet pressure for that run, the chart above resulted. It is now clear from the cluster of points near zero deviation that a pressure around 40 psig. gives an almost perfect material balance, which comes from maintaining a liquid phase in the reactor. However, the cluster at 10-14% deviation shows that a 20 psig. inlet gives erratic results due to slugging.

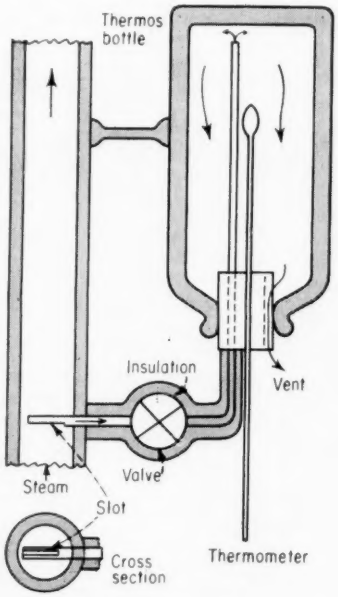
Simple Way to Measure Steam Quality

Robert Lemlich
Assistant Professor of Chemical Engineering
University of Cincinnati
Cincinnati, Ohio

In determining heat balances and the like on process equipment, we often need to know the quality of steam which is available. If this quality is high enough for estimation by throttling then the simple calorimeter described here will easily do the job.

For sampling we insert a short length of tubing, slotted at one end and preferably not over ¼ in. in diameter, into the steam pipe, with the slot facing upstream to catch droplets and thus assure accurate sampling. We connect the tube through a needle valve and notched two-hole stopper to an inverted 1-pt. thermos bottle of the ordinary type obtainable at the corner drug store. The tube and valve are insulated. A thermometer is inserted through the second hole of the stopper. The notch is generously proportioned and serves as both a drain and a vent.

To operate this device, first carefully crack the valve so that a small flow of steam enters the thermos bottle, warming it up to steady-state temperature. Initially condensate, and then steam, will issue from the vent.

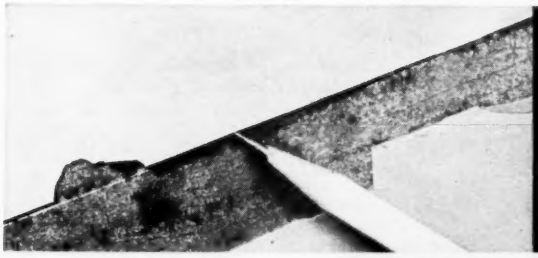


When a gentle flow of steam is leaving the vent (to insure there being only a slight positive pressure in the bottle), read the thermometer.

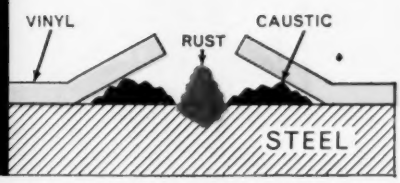
With the aid of the steam tables or Mollier diagram the temperature shown, at the existing barometric pressure, indicates the enthalpy of the steam. Tracing back on the chart to the line pressure at this enthalpy immediately shows the moisture content and hence the quality of the line steam.

PUZZLED ABOUT PRIMERS?

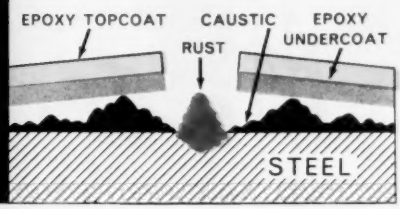
Here are tests you can duplicate

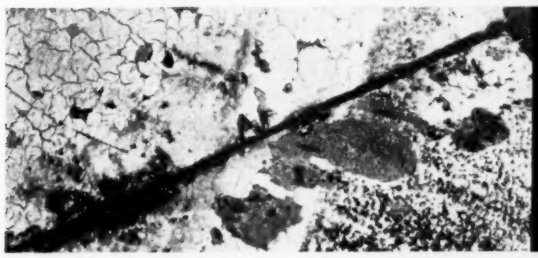


TEST 1—One coat of self-priming vinyl. Coating breaks away (L) due to severe undercutting (R), exposing metal to progressive corrosion.

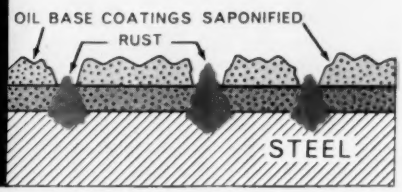


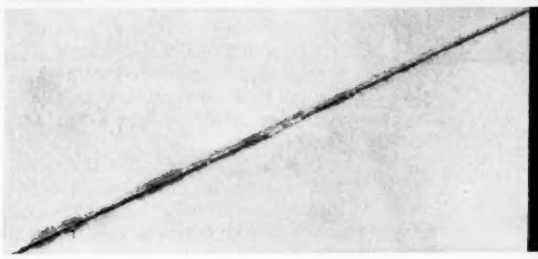
TEST 2—Epoxy primer, epoxy topcoat. Coating lifts off in single sheet (L) as adhesion fails (R), exposing entire surface to corrosion.



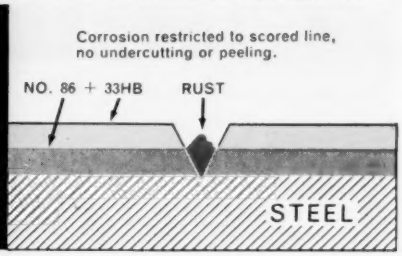


TEST 3—Oil primer, oil topcoat. Both coats fail completely (L) as underfilm caustic reacts on their oils to form soaps (R).





TEST 4—Amercoat's No. 86 inhibitive primer and No. 33HB vinyl topcoat. Corrosion restricted to scored line (L), no undercutting or peeling (R).



The purpose of these accelerated tests is to show what happens when various types of coatings are exposed to a typical corrosive environment. Four clean steel panels, free from mill scale and rust, were coated with different combinations of primers and topcoats. Each was scribed to bare metal and immersed in salt water in the presence of free oxygen, for two weeks.

As caustic deposits formed over cathodic areas of the steel in tests 1, 2 and 3, failure occurred in three ways. The vinyl, though not directly attacked, was undercut as caustic spread beneath the film and destroyed adhesion. The epoxy coating, known for critical adhesion to smooth metal, proved impervious to caustic attack. It was, however, lifted in its entirety as moisture spread beneath the surface. The entire oil paint film was quickly penetrated by the salt solution, creating widespread corrosion and caustic formation. The caustic then reacted with the oil to saponify the film.

In the fourth test the corrosion was limited to the score mark. Reason: Amercoat No. 86 Primer resists undercutting and adheres tenaciously, inhibiting electrolytic corrosive action.

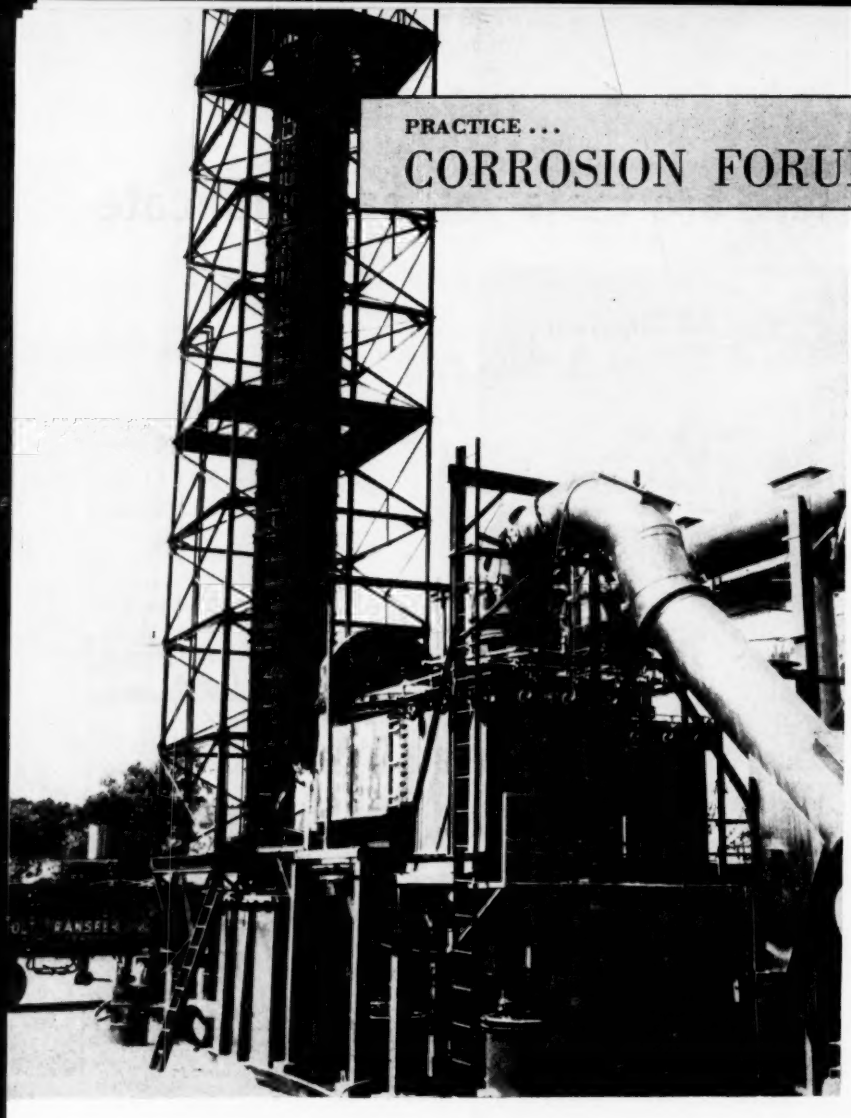
The conclusions are clear. To provide long term protection in corrosive service, start with Amercoat No. 86 Primer, which provides a sound and lasting base for quality topcoats such as Amercoat No. 33HB.

Write today for complete data on Amercoat No. 86, and have the details on hand when planning your next important coating job.

Amercoat CORPORATION

109 Dept. AD

4809 Firestone Blvd., South Gate, Calif.



HOW TO SPOT GOOD AND BAD . . .

Design of Plastic Towers

When buying plastic equipment, look for adherence to the factors which mark a competent design.

P. L. McWhorter, Haveg Industries Inc., Wilmington, Del.

A plastic tower is a complicated piece of equipment, compared to a plastic tank. Usually towers are equipped with a multiplicity of fittings and accessories, both inside and outside.

All the important plastics available for tank construction are used in plastic towers (*see Chem. Eng., Mar.* 24, 1958). This includes phenolic, furan, polyester and epoxy resins, with and without reinforcement. But because of complex parts, proper design of plastic towers is a critical factor, perhaps more than for tanks.

▶Watch for Good Design — Through experience, a number of basic rules for good tower design have been developed. These rules apply for any plastic equipment with complex components. They can be used to distinguish between competent and incompetent design:

• Sections should be designed, where possible, with a uniform thickness. This will tend to offset unequal shrinkage in such places as a rim molded to a tower wall for support of a grid bar assembly in packed towers.

• Avoid sharp angles and abrupt section changes, to minimize part failure.

• Fillet all sharp angles. This is to reduce stress concentrations in service and to prevent cracks during the molding operation. Relatively large fillets should be used.

• Bring minimum of adjoining sections together. Avoid concentration of material by staggering cross-members or ribs.

• Avoid molding strain—molding design creating a variation in curing rates between different parts is a common cause of molding strain. Cracks, distortion and structural weaknesses usually result from differential contraction.

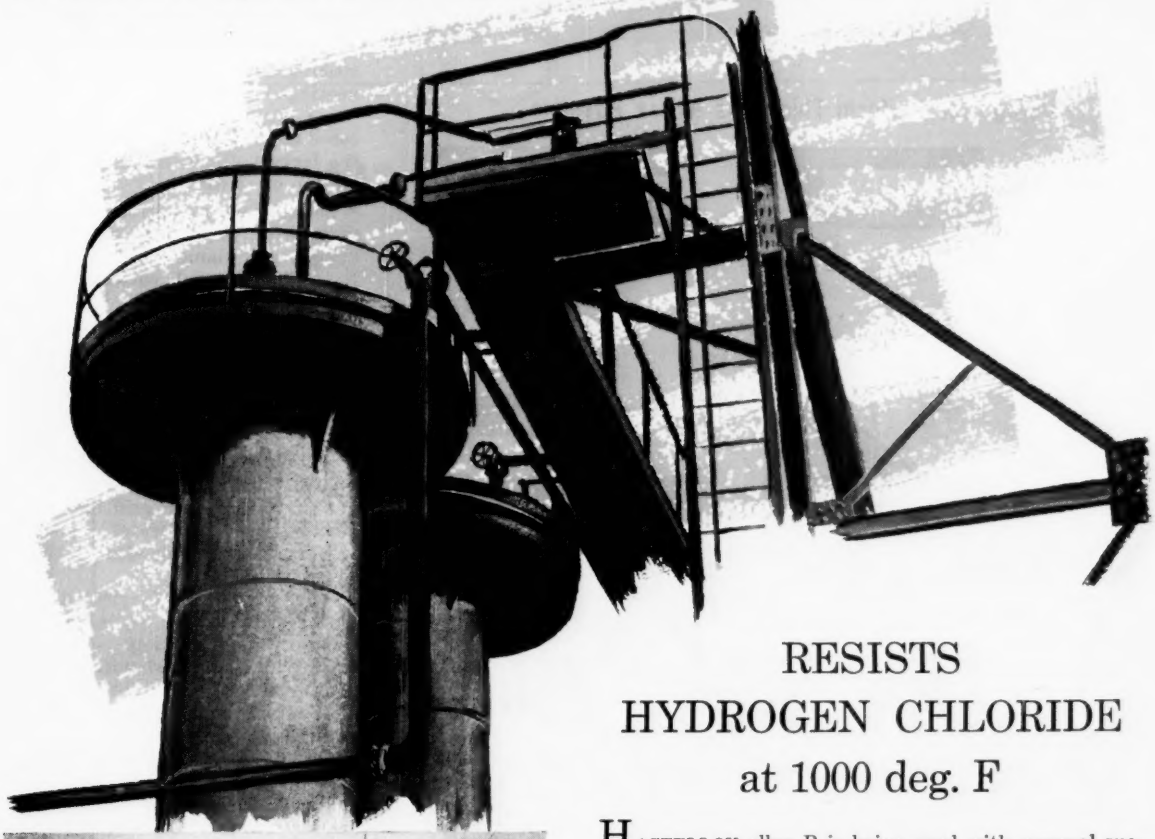
To reduce or prevent molding strain avoid sudden changes of form, producing a corresponding change in the direction of shrinkage. And avoid widely differing section sizes.

Due to restrained contraction and curing of the uneven sections, a rim will have tension strains, with corresponding compression forces in cross supports and center sections. The cross supports should have a curing rate very close to that of the center section.

• Bosses and pads should not be used unless absolutely necessary. They increase the thickness of the material and create curing problems, shrinkage and possible blistering. A continuous rib instead of a series of bosses permits less expensive molds.

• Design ribs and gussets for maximum effectiveness. Ribs have two functions. One is to improve stiffness, and the other is to reduce weight and avoid warpage. Correct rib size and

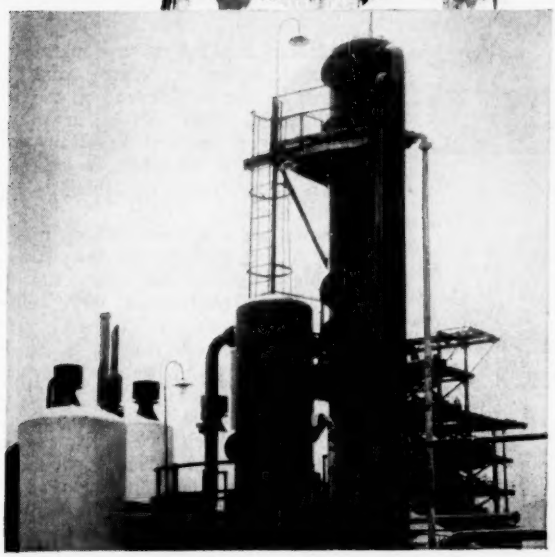
HAYNES Alloys solve the *tough* corrosion problems



RESISTS HYDROGEN CHLORIDE at 1000 deg. F

HASTELLOY alloy B is being used with unusual success in equipment exposed to hot hydrogen chloride gas containing water. In one installation, where the highly reactive gas is at 1000 deg. F., alloy B has outlasted previously used materials by 30 to 40 times! Here, tower covers, piping, and valves made of alloy B are located on top of chlorine burners in a tetraethyl lead plant. They were in service for 6 years before requiring maintenance.

Hydrogen chloride gas is only one of thousands of corrosives that are successfully handled by HASTELLOY alloys. These nickel-base materials have unusual resistance to the hot mineral acids, strongly oxidizing salts, and powerful gaseous oxidants. For complete information, send for the newly published booklet describing these alloys. Write to Haynes Stellite Company, Distribution Section, 30-20 Thomson Avenue, Long Island City, N. Y.



Concentrated Sulphuric Acid flows across perforated trays made of HASTELLOY alloy B in these drying towers. Alloy B resists the corrosive effect of the acid and helps maintain the efficiency of the tower. The trays have been in use since 1949.

HAYNES ALLOYS

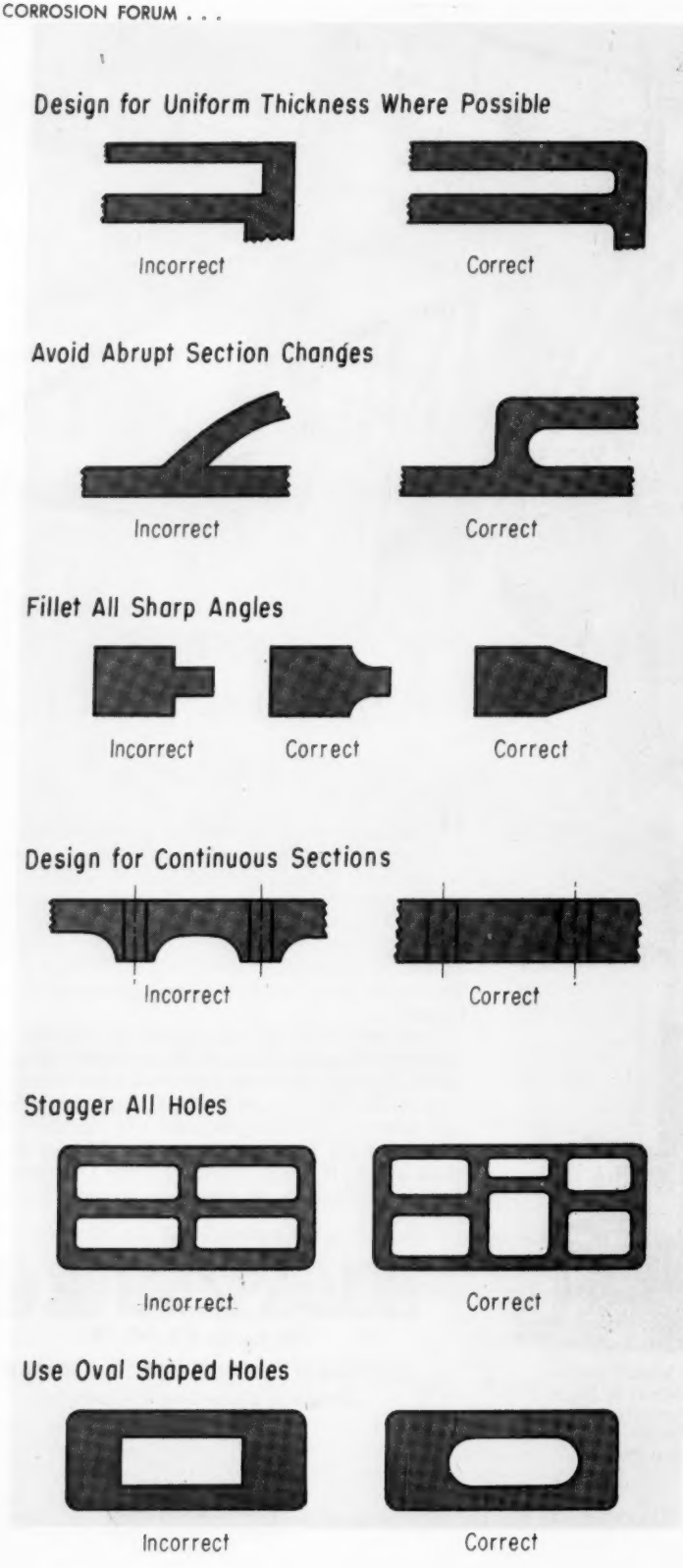
HAYNES STELLITE COMPANY

Division of Union Carbide Corporation

Kokomo, Indiana

UNION CARBIDE

"Haynes," "Hastelloy" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.



spacing depends on overall engineering design.

• Avoid rectangular shaped cored holes. Use oval shapes with the largest dimension in the direction of stress.

▶ **Tower Types** — From a use standpoint, plastic towers are available in diameters from 1 to 12 ft. Types include packed, tube, and plate; for pressure, vacuum and atmospheric applications.

Packed plastic towers consist of deep cylindrical or rectangular tanks with covers, and inlet and outlet connections for gas and liquor.

To retain the packing and provide a drain space below it, packed towers have grid bar assemblies, or perforated plates resting on a rim molded in the tower wall.

Tube towers are fabricated in either square or rectangular cross-section, to any desired height and equipped with horizontal tubes. Straight tubes, U-tubes, bayonet heaters or coils, can easily be installed.

The design versatility of plastics allows alternating packing and tubes, making it possible to perform a dual function with a single tower.

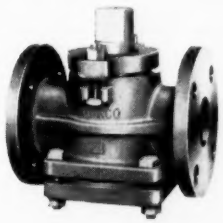
Bubble cap towers are plate columns. Number, shape and size of bubble caps depend on the application. They can be made removable or molded as an integral part of the plate, as can down-pipes, drains or other internal piping.

Sieve plate towers follow, in general, the same design as bubble caps, except that the plates are perforated with a large number of small holes.

Cascade towers consist of a series of plates, with relatively large cut-out areas, staggered in alternate plates. Flooding or build-up of back pressure presents no problem. This type of plastic tower has been used where a large volume of liquid absorbs or washes a relatively small volume of gas.

▶ **Unusual Accessories** — It is important to remember that plastic accessories are installed in a different manner from similar metal components.

Although plastics may be threaded, better connections are often attained by the use of nipples and insert connections.



The **Durco type "F"** valve could be the valve you've been looking for!

It is extremely simple in design, has a removable Teflon sleeve and is made in several rugged corrosion resisting alloys. There are thousands of happy users of Durco Type **"F"** valves in the chemical industry.

DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

AVAILABLE IN SIZES FROM 1/4" THRU 4"

THE DURIRON COMPANY, INC. / DAYTON, OHIO

Nipple type connections are the most common means of connecting towers and piping. They can be installed in almost any location; even flush with the bottom in the wall of a flat bottom tower. They can also be installed at any required angle.

These nipples are short sections molded into the tank, employing split metal flanges for the connection to pipe. Very often the wall thickness of nipples is heavier than the pipe. In these cases special adapter flanges have been designed to complete the connection.

Insert connections (not as popular as nipples) require a plastic boss into which threaded metal inserts are molded. Threaded pipe connects to this.

In some cases, where the pipe line is rigidly connected to other equipment, where center distances or alignment are not exact, or where there is likely to be vibration in the piping, a special expansion nipple connection is available.

Often a purchaser might want to make some design changes but may not be willing to send the tank or tower back to the factory for remodeling. To meet this situation, three removable nipple connections are produced.

Sight glasses are commonly bolted to towers and a whole range of gages can be attached and detached by various connecting devices. In general, however, design of these connections doesn't differ greatly from that for the elementary nipples and inserts for ordinary process pipe fittings.

"New" Nickel Hard but Flexible

A novel, unusual form of electrolytic nickel has been announced by Metachemical Processes Ltd., Crawley, England (soon to be introduced in this country). Very fine grained, it is hard enough to resist filing (Brinell 600), but it can be bent easily without cracking.

The material appears promising for corrosion protection.

Secret is a conductive plastic coating placed over a mandrel, cast to the contours of the part to be protected. Nickel, from an ordinary sulfate bath, deposits on this coat, taking on the fine-grained plastic properties.

Nickel plate is removed and cemented into position.

Low-Cost Heat Transfer With Expandable Al

Alcoa is about to start mass production of their new Expandable Tube-Sheet product in special equipment installed at Alcoa, Tenn. A unique, one-piece unit of aluminum sheet, or plate, it contains a series of lengthwise, parallel areas that can be expanded easily to form integral tubing.

Made without complicated joining or fabricating procedures, the tubing can handle circulating liquids and gases without leakage. The result is a low-cost piece of equipment for heat transfer and similar applications.

Available in practically all non-heat-treatable alloys, and in heat-treatable 6061, 2024 and 7075 alloys, the product will be shipped unexpanded as coiled and flat sheet.

When expanded, either hydraulically or with air, a variety of shapes can result by restraining the tubes in dies. Free inflation produces round tubing. It's also possible to have aluminum sheet flat on one side and tubed on the other. Tube diameter can be varied within a single aluminum sheet.

One big outlet, according to Alcoa, should be in heat-exchangers. Refrigerators, air conditioning units, panel heating for buildings, air coolers for aircraft also offer potentially large markets.

The material is under investigation as an aluminum skin covering for supersonic aircraft and as a carrier of de-icing gases or solutions on aircraft wings.

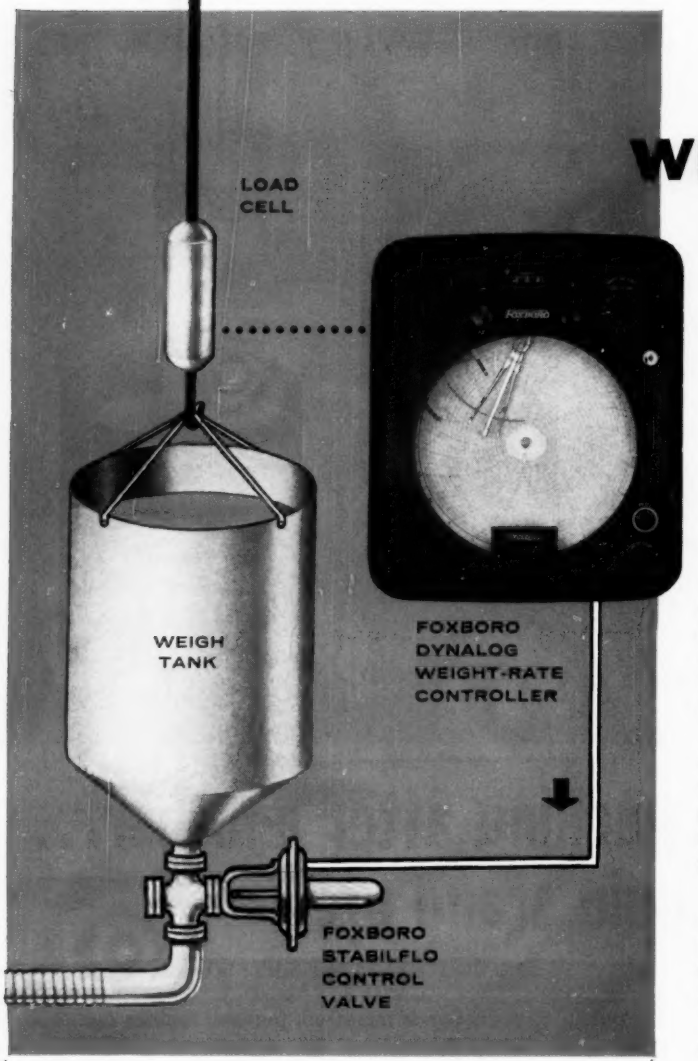
One Coat Gives Protection

A new one-coat maintenance paint can be used in chemical plants without costly surface preparations.

Based on a Bakelite vinyl acetate latex, the coating is standing up well on porous cement and a variety of metals after 2½ yr. in a plant test application under acids and alkalies.

The new coating dries in two hours, can be scrubbed after 24 hours.

problem of
metering "tricky" liquids
eliminated!



HOW IT WORKS The Foxboro Weight-Rate Flow Control System controls weight of liquid passing from a weigh tank suspended from a load cell (either hydraulic or strain gauge-type). Cell continuously measures decreasing weight of liquid. Controller records weight, controls time of draining, and sends pneumatic control signal to a Foxboro Stabilflo Valve installed in drain line. After correct amount of liquid is taken from tank in the desired time, controller automatically closes valve.

Foxboro WEIGHT-RATE SYSTEM

accurately controls flow rate of any liquid that will pass through a pipe

Here's a Foxboro batch control system designed especially for liquids that undergo wide fluctuations of density, temperature, or viscosity. Small volumes, corrosive liquids — even liquids that stick to the side of a tank will not affect the system's accuracy.

The Foxboro Weight-Rate System controls flow rate by weight of liquid rather than by volume. Functions of a load cell; a Dynalog* electronic recorder; and a Cyclelog* pneumatic controller are coordinated to do this.

Operation is simple. You merely set weight of liquid, dial the desired time, and push a button. The automatic control system does the rest, while keeping an accurate record of the whole process.

Best of all, the Foxboro Weight-Rate System requires practically no maintenance. That's because neither the measuring element nor the controller ever come in contact with the process liquid.

If batch operations with "tricky" chemicals are your problem, Foxboro has the answer. Call your local Foxboro Field Engineer for full details, or write **The Foxboro Company, 364 Neponset Ave., Foxboro, Mass.**

*Reg. U.S. Pat. Off.

FOXBORO
REG. U.S. PAT. OFF.
FLOW CONTROL SYSTEMS

Chemical Engineering

People

APRIL 7, 1958

Department Index

What's Wrong With Engineering Education

James R. Killian, Jr., special aide to President Eisenhower, outlines how we can achieve a new level of excellence.

FIRST we need to give greater emphasis to qualitative factors in our education and to the identification and education of high talent. Our manpower shortage in science and engineering has been and will continue to be more one of quality than of numbers.

In our secondary schools we need to identify aptitudes and talent at an earlier stage and make special provision for those who have exceptional aptitudes and talent. We need to lay a good foundation of mathematics and science for all students able to profit from them, which is most of them.

We need to take advantage of the great resources of our liberal arts colleges for the encouragement of scientific talent.

We need to strengthen our engineering institutions and to recognize their increasing importance in our system of higher education. It is especially important that these schools provide an education which is more fundamental and which produces men of greater versatility because their education is fundamental. It is of critical importance that we extend the opportunities for graduate study in engineering.

Finally, we must achieve a wider understanding of science. We need to demonstrate that science is an essential part of an education that is thoroughly liberal for our time, and that there need be no conflict between science and the humanities.

These are some of the tasks we face in the great technological competition that lies ahead.

Cornell's Fred H. Rhodes, observing chemical engineering education for 25 years, tells us about its shortcomings.

SOME time ago, when I began to realize that the relentless pressure of time would force the blackboard crayon from my unwilling fingers, I vowed that when I retired I would sing no swan song of sad regret. I know full well that I am no swan, and besides that I can't sing.

History does not, however, record a single instance in which any college professor successfully resisted the temptation of a captive audience.

Having grasped avidly at the hint that I might speak a few words—which hint I magnified in my own mind to an irresistible popular demand that I speak at considerable length—I was faced with the selection of a topic.

If I were wise, I should have selected some perfectly innocuous and noncontroversial topic. This would be safe, but not very exciting. Instead, I have been so indiscreet as to elect to speak of some of the shortcomings of the American system of university education, with particular reference to engineering education and with most specific reference to the education of chemical engineers.

This topic is, or should be, of very great and very direct importance, not only to the universities and to the chemical process industries, but to all industry and to the national welfare generally.

I think that all of us will agree that in the years to come we shall need many more men with engineering and scientific training and that these men must be very thoroughly prepared to fill positions of high technical and administrative

responsibility. We are not today supplying enough men to meet this need, and many of the graduates are not as adequately prepared as they should be for their immediate and future responsibilities.

Industry is sometimes inclined to place the blame for this on the universities. The universities shift the blame to the secondary schools, claiming that the young man who enters college today is not as well prepared as was the entering freshman of years past. The secondary schools blame the influence of television, changes in home life, and other factors.

All of these claims may have some basis of truth, but the fact remains that the universities themselves are not doing as good a job as they should be doing or as they could be doing.

One reason for this failure to operate at fullest effectiveness is the stubborn reluctance to depart from traditional and outmoded methods of instruction. It has been said that the military establishment is always preparing for the last war. I don't know about this; I can't qualify as a military expert.

However, it seems to me that the universities are always training for the last generation. The body of information in every one of our branches of science and engineering has grown so enormously in the past few years that it is becoming increasingly difficult—if not impossible—with our present methods of instruction, to train a competent man for effective professional work, even in a five-year curriculum.

Our task is made more difficult by the requirement that the competent engineer of today must have some facility in many fields other than that of his special interest. He must be able to express himself effectively, both orally and in writing; he must be able to work effectively with others; he must have some appreciation of the historical background of his profession and of the impact of his work on society.

I think that in all fairness I should here soften the implied criticism of university procedures and university faculties. It has been my experience over the years that most faculty members are willing to assent to rather radical changes in instructional procedures — provided only that they do not involve or touch upon their own courses.

Another criticism that I would offer is that university instruction sometimes seems to be cleverly designed to stifle any individual initiative. Young men entering our engineering schools today are really a selected group. By all of our available criteria, they represent the top very small fraction of the men of their age group throughout the country. At least, most of them have developed professional interest; they have elected to become engineers because they feel that the profession of engineering offers interesting and challenging opportunity.

On their arrival at the university, they are herded into sections — laboratory sections, recitation sections, lecture sections. In the laboratory, they are handed instruction sheets that describe exactly how to assemble the apparatus, exactly how to conduct the experiment, and exactly what to observe. In the recitation sections, they are told exactly how to solve certain problems.

Henry Is a Jerk

In the English sections, they are required to submit themes on assigned topics; usually topics of no real interest to the student.

In all of my experience at Cornell I know of but one English theme that was a classic in descriptive writing. This was submitted in response to a requirement that each student describe his roommate. The young author dared to break away from the procedure specified by his instructor to guarantee effective writing.

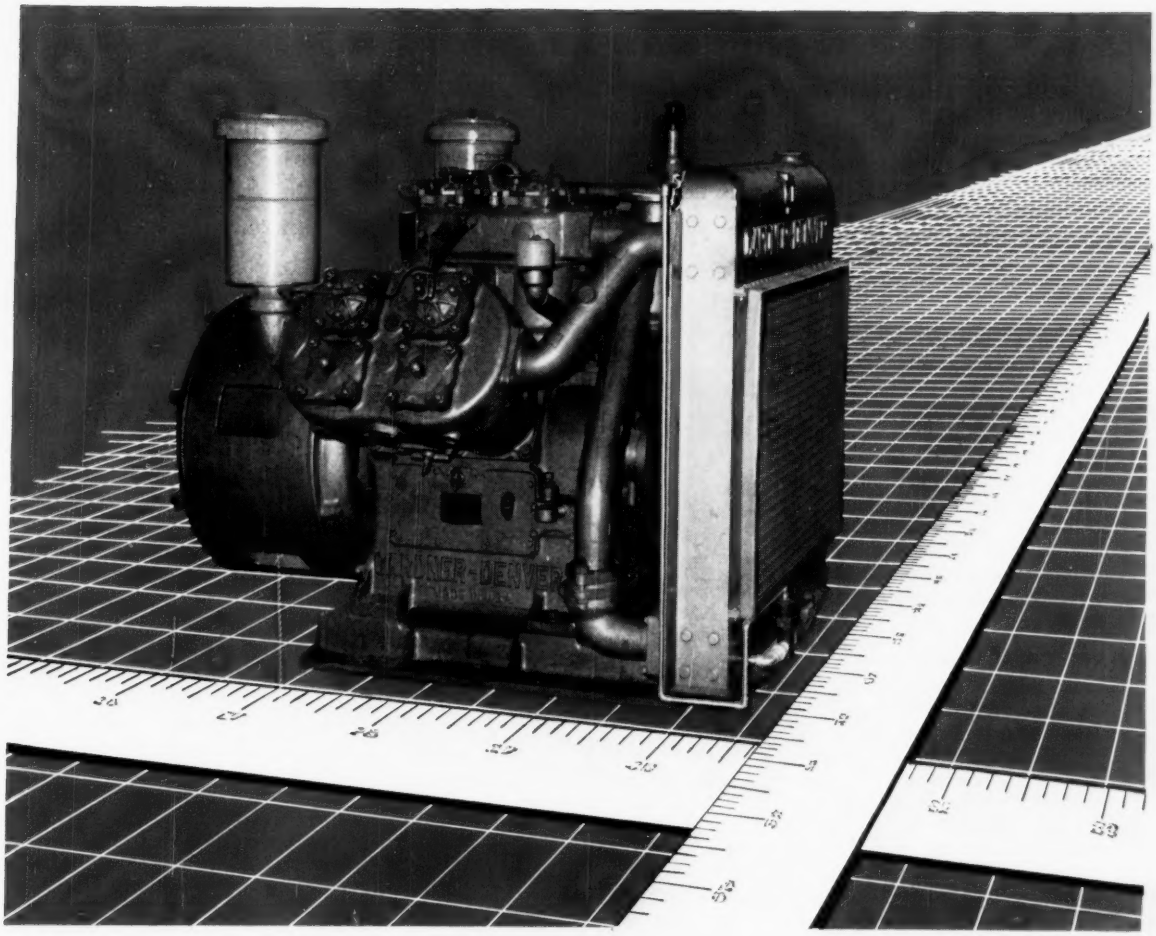
He wrote from the heart, with imagination and feeling. His theme was short. It consisted of a single sentence:

"Henry is a jerk."

The author received a grade of zero. I would have graded the theme as perfect. It was concise. It was complete; anything more that might have been said would have subtracted rather than added. It was correct; I knew Henry and he *was* a jerk.

I am not proposing that every underclass student be turned loose in the laboratory to do anything that he wants to do without advice or instruction. I am not suggesting that mathematical principles should not be taught by problems that apply and exemplify those principles correctly. I am not suggesting that the best way to teach a student to write correct and effective English is not to provide practice in writing and careful and constructive criticism of what is written.

I am merely asking that, from the very beginning of his stay in the university, he be given some opportunity and some help



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to develop initiative and originality of thought.

To encourage this originality and to guide without directing its development presents a real challenge to our own imagination and to our ability as teachers. Here we can no longer rely on textbooks or laboratory manuals or set lectures before large classes.

There must be close contact and mutual understanding and respect between the teacher and the individual student, or between the teacher and very small groups of students. It will require on the part of the instructor that same freshness of thinking that we are undertaking to develop in the younger men. This will not be easy; I do not think that it is impossible.

This Can Be Expensive

Of course, there is one little disadvantage to this kind of teaching; it is expensive. It's so much easier to stand before a large student audience and deliver a prepared lecture than to try and get to know the men as individuals and to try to give them, as individuals, the help that they really need.

My greatest criticism of the American university education in general is the decreasing emphasis on really effective undergraduate instruction. There are

several causes for this. One is the great number of sponsored research projects offered to and being accepted by the universities.

When a sponsored research project is offered to a university, the usual immediate effect is the withdrawal of the most competent professor in that field from some or all of his undergraduate teaching so that he may be assigned to the project.

Another cause for the deterioration of undergraduate teaching is the reluctance of many of the senior staff members to undertake the instruction of undergraduates. The result is that during those most important formative two years

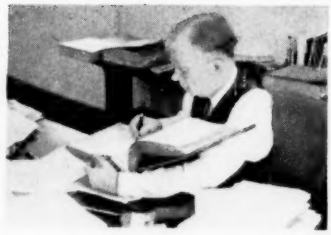
of his course the young student does not come into real contact with any senior professor on the staff.

Of course, sometimes the lectures in an introductory course are given by a senior staff member. For three hours each week, the young man sits 10 or 50 or 100 ft. in front of the speaker, and listens to the prepared lecture. To him the professor is usually a rather peculiar, but doubtless estimable old gentleman, who appears promptly on the hour, opens a notebook, talks for 50 minutes, closes the notebook, asks if there are any questions and then disappears.

I admit that the picture is not always quite as black as I have painted it. Some of the younger men are really competent and interested teachers who have the rare ability to establish contact with their students and to be of real help to them. Unfortunately, this is usually the result of happy accident rather than intent.

I am not suggesting that every senior professor should devote his entire time to teaching freshman or sophomore courses, or even to teaching undergraduate courses. I do not advocate that he should be denied the opportunity to conduct advanced or graduate courses or to direct research.

I am asking only that the men



of greatest professional competence and longest experience and most skill in teaching be brought into close contact with undergraduate students early in the course and throughout the course; and that they not be assigned largely or solely to graduate instruction and research.

Of course this policy is expensive. It would be so much cheaper and financially more efficient to delegate the job of teaching to younger and more poorly paid instructors. At Cornell we have not learned to operate very efficiently, unfortunately. We have been reluctant to appoint to the faculty—at any level—any man who has not had several years of successful, responsible professional experience as a chemical engineer in industry.

We have felt that our primary obligation is to train competent chemical engineers for industry—men not only competent to handle their first jobs effectively, but also capable of growing with experience and responsibility. We believe that this training can be given best by men with experience in the field; men who understand the conditions under which chemical engineers work and the requirements for success in the profession.

I do not say that professional success in industry—even outstanding success—is alone a guarantee of success in teaching. Some of our most eminent engineers would not be good teachers and would not be happy in teaching.

I do say that the man who lacks the qualities necessary for success in industry lacks also the qualities necessary to train the chemical engineers of the future.

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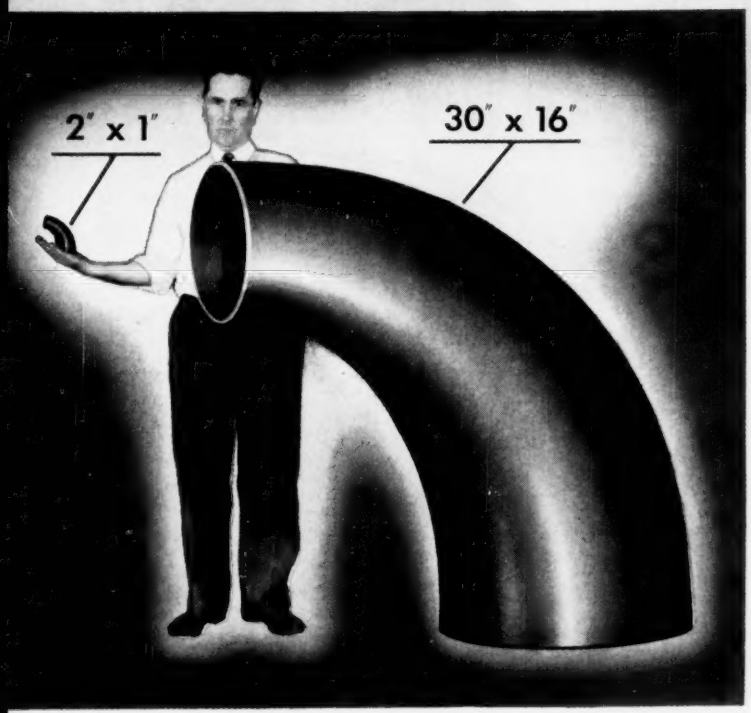

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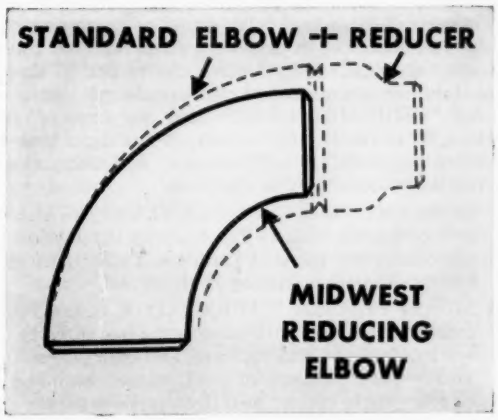

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PEOPLE . . .

TECHNICAL BOOKSHELF

J. B. BACON

Synthetic and Glass-Fiber Capacities

(million pounds)

	1954	1957	1975
Rayon and acetate	1,651	1,535	2,000
Synthetics	439	627	2,000
Glass	73	140	600
Total	2,163	2,302	4,600

Source: Chemical Week

IMPACT of synthetics means major new chemical markets.

Good Information

TEXTILE CHEMICALS AND AUXILIARIES, With Special Reference to Surfactants. 2nd. ed. Edited by Henry C. Speel and E. W. K. Schwarz. Reinhold Publishing Corp., New York, N. Y. 517 pages. $13.50.

Reviewed by L. D. Berger, Jr., Union Carbide Chemicals Co., New York, N. Y.

Milton Harris, that genial authority on textile technology, recently referred to the textile industry as essentially a mechanical process. As he and many others have observed, however, this industrial giant is stirring, and an era of change is at hand.

Unsettled by the impact of the new synthetic fibers on old, established ways, the textile processing industry increasingly recognizes chemistry as one key to development and production problems. Thus there is a widening acceptance of common cause between the chemical industry and the textile processing industry in the United States.

Chemical process industry people sense in this development the growth of a major new potential market. At the same time, textile people anticipate facing chemical application and development problems that may be almost without precedent. Rapid change in the loosely defined area of overlapping interest between the textile and chemical industries has prompted Speel and Schwarz to revise their earlier edition of "Textile Chemicals and Auxiliaries."

▶ **Timely, Short Course** — The publication of the second edition is most timely. It is a short course in textile chemical technology presented by a number of writers, each thoroughly familiar with his subject. The resulting compendium should serve as a welcome source of orientation for both textile and chemical people who face new problems in this challenging field.

▶ **Two Sections** — The book is presented in two major sections, the first covering "The Nature and Processing of Fabrics". Here are discussed in 8 chapters the physical and chemical nature of textile fibers, and the major processes employed in creating from the individual fiber a finished textile article.

Part II is called "Raw Materials in Fabric Processing". It is in fact a comprehensive review of the "Textile Chemicals" referred to in the book's title. The materials covered include water; fats, oils and waxes; starches and gums; solvents, and numerous resins and finishing agents. In recognition of the major importance of the textile industry as a consumer of surfactants, six chapters in this section are devoted to a quite comprehensive review of the chemistry and application of soap and the various synthetic surface-active agents.

▶ **Many References**—Each chapter throughout the book is ac-

companied by an extensive bibliography, and many are supplemented with references to background literature and historical sources. The reader wishing to undertake more extensive study of a particular area of textile chemical technology will find here a very good reference source.

From a readability standpoint, this book is erratic, as might be expected in a collection of chapters by many authors. Some portions are presented in remarkably readable and polished style for a technical volume. The chapter on textile finishing by H. H. Mosher deserves particular mention for readability. On the other hand, some authors lapse into the use of undefined technical terms and phrases, particularly with regard to textile processing operations. This leaves the inexperienced reader somewhat baffled at times. The inclusion of a glossary of terms as an appendix would do much to alleviate this problem in future editions.

▶**Easy Going**—In general, the book is good, solid semi- technical prose and with the exception noted above, it is easy going for anyone with average chemical or chemical engineering background. The reader will find himself annoyed occasionally by typographical errors and even line transpositions that call for more careful editing. No doubt these minor irritations will be corrected in future printings.

On the whole, one must commend Speel and Schwarz for assembling a substantial amount of good information on textile chemicals in one very reasonably sized volume.

BRIEFLY NOTED

ILLINOIS MANUFACTURERS DIRECTORY. 1,800 *pp. Manufacturers' News, Inc.*, 20 *East Huron St., Chicago, Ill.* $25. Gives complete rundown of the State's 20,000 manufacturers, listing companies by product, by city and by name, alphabetically.

ENGINEERING AND TECHNICAL CONVENTIONS. *Industrial Relations News, Inc.*, 230 *W.* 41 *St., New York* 36, *N. Y.* $3. per year. Includes date and place of meetings and conventions for major societies and organizations.

PEOPLE...

MEET YOUR AUTHORS

M. A. GIBBONS

CHOU HSIUNG LI: There's an art to handling statistics.

WORKSHEET GIVES OPTIMUM CONDITIONS. PAGE 151.

"About three years ago," Chou Hsiung Li writes, "I designed a worksheet similar to but simpler than the one presented in my article.

"That worksheet could include up to seven factors on eight samples—results of which are rapidly analyzed by the Yates method. It was successful in solving factory problems and in finding new alloys or compositions.

"Later, I learned the new Box method from Davies' book on Industrial Experiments. The method of response surfaces and steepest ascent is therefore included to make the worksheet even more useful."

Result: the current article.

Chou Hsiung Li was born in China. He obtained his bachelor's degree in mining and metallurgical engineering there in 1944. Four years later, he came to the United States to attend Purdue University. The following year, in June 1949, he earned a master's and by January 1951, he had his doctorate. Minors were in mathematics and in general engineering.

During the course of his graduate work, Li completed a large number of experiments on steel chromizing electroplating, and hot hardness.

Right after graduation, Li joined Radio Corporation of America as a metallurgist. For RCA, he has concentrated on the development of new materials and processes with the use of modern statistics. He also advises other engineers on the use of statistics.

Li is an associate member of Sigma Xi, a senior member of the American Society for Quality Control and among the "American Men of Science." Among the papers he has published, one won for him the 1955-56 Nomography Award of the American Society for Engineering Education.

Hobbies include bridge, sports and photography.

AUTHORS . . .

Lloyd M. Polentz

HOW TO DESIGN FOR RADIANT HEATING. PAGE 137.

When we last wrote about Lloyd Polentz in these pages (see *Chem. Eng.*, July 1957, p. 314), he was a technical specialist for Robertshaw-Fulton Controls.

Since that time, though, he has taught a summer session for UCLA's Engineering Extension Division, completed requirements for his master's degree in engineering (also at UCLA) and begun a teaching stint on the physics and engineering staff of Cerritos College.

In addition, Polentz handles various projects as an engineering consultant for the Accessory Products Corp., Whittier, Calif. And, incidentally, he's now also a registered professional engineer in his home state.

He hasn't been idle as an author, either. After last July's "Basic Equations are Faster and Accurate," Polentz turned out "Calculate Fluid Flow by Basic Equations," (*Chem. Eng.*, Aug. 1957, p. 282), and "Flow Meter for Maximum-Minimum Flow," (*Chem. Eng.*, Oct. 1957, p. 310).

Polentz began his career in engineering in 1943, by holding down a job while working for his B. S. at night. When the University of California gave him that degree in 1945, he started working for Kobe, Inc., on hydraulic oil well equipment.

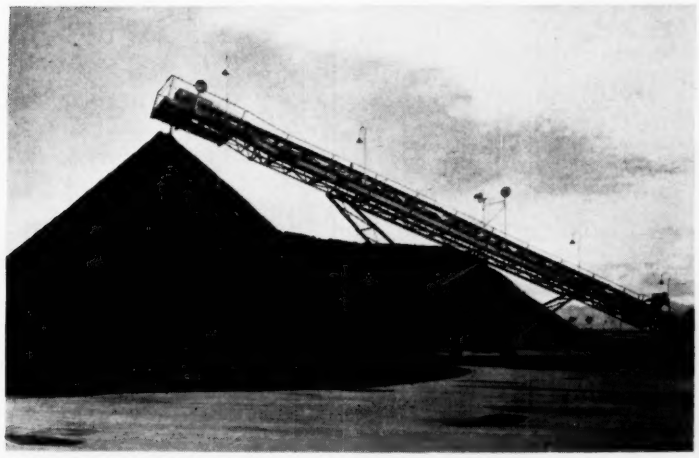
For the next three years, Polentz taught in UCLA's engineering department.

Later he became senior engineer for UC's mechanical department, in Berkeley. Later, he worked as a process engineer for Pabco (on fluid flow and radiant heat transfer). Then, came a similar assignment for UC's radiation lab.

PEOPLE...

LETTERS: PRO & CON

C. H. CHILTON



SOLIDS TO GASOLINE: Commercialized first in Europe.

Gilsonite Was Not First

Sir:

In your stories about American Gilsonite Co.'s operations in Colorado, you describe the project as being "the first large-scale, privately financed project to produce conventional petroleum products from a solid raw material."

From 1935 to 1939 a large-scale plant was operated by the Billingham division of Imperial Chemical Industries to make from bituminous coal very substantial tonnages of motor spirit conforming to the then current commercial specifications. The product was marketed by the oil companies. The project was described in some detail in a paper delivered by Kenneth Gordon to the Institute of Fuel in December 1935 under the title, "The Development of Coal Hydrogenation by Imperial Chemical Industries Limited."

Even earlier than this (1927-30), I. G. Farbenindustrie was operating its plant at Leuna, hydrogenating brown coal to make motor spirit for the German market. Later wartime plants in Germany were based on this experience.

W. J. V. WARD
Imperial Chemical Industries Ltd.
Billingham, England

▶ *You've got to get up mighty early in the morning to get ahead of these clever Europeans.*—ED.

Back to the Good Old Days?

Sir:

I am gratified to learn from a recent letter in your magazine (Feb. 10, 1958, p. 164) that the engineer shortage continues and, indeed, that persons who assert that there never was an engineer shortage are sadly mistaken. This is mighty good news, since the advent of "normalcy," with $20 per week salaries—I should say wages—is deferred for the present time.

Back in 1932 thousands of engineers worked at wages of $20 per week with the largest corporations in this country. Indeed, I was employed (with many others) at a wage of $12 per week as an engineer. Two years earlier these same men had salaries averaging around $200 per month—about half of what a movie projectionist or truck driver made in the boom days before the normal times of the depression, which latter times the employers of engineers now

yearn for so fondly. Be of good cheer; these happy times will come again!

The astounding thing is that *Chemical Engineering* is the only publication known to me which dares to publish the truth on engineers' salaries and employment conditions.

HENRY ECKHARDT
Fair Oaks, Calif.

More on Rupture Disks

Sir:

I have just finished reading the article, "Calculate Adequate Rupture Disk Size" (Jan. 13, 1958, pp. 157-8). It seems to me that Mr. Lowenstein has done an excellent job in assembling data and drawing logical conclusions therefrom.

A word of caution with respect to application of this method: The maximum pressures shown on the chart are those resulting when the reactants are initially at atmospheric pressure, as stated in the article. If reactants were initially at more or less than atmospheric pressure, the maximum pressure figure would be different.

Taking Point No. 11 (ethane) as an example, the final pressure shown in the chart is about 100 psi. If, however, the reactants were initially under an absolute pressure of 2 atm. (15 psig.), the final maximum pressure, assuming no heat loss to the vessel wall, would be approximately 200 psi. In other words, the maximum pressure figures should be multiplied by a factor equal to the initial absolute pressure expressed in atmospheres.

W. H. DOYLE
Factory Insurance Assn.
Hartford, Conn.

► *Author Lowenstein acknowledges the validity of Mr. Doyle's comment. In the following criticism of the article, we have interspersed excerpts from the*

author's detailed reply at appropriate places.—ED.

Sir:

I should appreciate some amplification of J. F. Lowenstein's article on rupture disks.

In the solution to the problem, the amount of vapor before rupture is calculated from a pressure of 115 psia. This seems a gross error, since it implies that the explosion has not yet started; the temperature used is the original 150 F. And pressurization by any means other than explosion would vitiate the entire calculation, since the basic data in the chart are good only for an initial pressure of 1 atm.

[If we are interested only in the number of moles of gas or vapor in the tank prior to start of the reaction, than 15 psia. would, of course, be the correct pressure to use in the formula $W'=PV/RT$, and the answer would be 0.0305 moles instead of 0.234 moles. However, in relation to the rest of the problem, namely, finding of a rupture disk diameter (*see below*), we are justified in using the final pressure.]

The calculation for rate of venting is also open to question. Maximum pressure for ethylene in a closed vessel is 105 psi. (120 psia.), attained in 0.018 sec. The disk withstands 115 psia. and, therefore, will not burst until, say, 0.017 sec.

After 0.017 sec., the explosion will continue (not necessarily for 0.001 sec., since the vessel is no longer closed). The vent must perform its function during this shorter interval, but on the other hand it need release only enough vapor to prevent exceeding 115 psia. The exact calculations would be much more complex than the author's simple division of total weight of contents by the 0.018-sec. interval, and the results will probably be different.

[Right. The correct calculation would be quite a bit more complex and would indicate a smaller relief device than called for in the example. Since the pressure in the tank will be equalized with that of the atmosphere in the shortest possible time interval, use of the 0.018 factor appears justified as a conservative approach.]

The author substitutes the

PRO & CON . . .

molecular weight of the original mixture in the discharge formula, but the original mixture no longer exists.

[Right again, but calculation of the molecular weight of the new mixture is both cumbersome and unnecessary, since the average molecular weight of such a mixture is rarely much different from the original mixture. In addition, the diameter of the rupture disk varies only as the 0.25 power of the molecular weight; hence the "error" is usually less than 2%.]

In the same formula, "no increase in temperatures is assumed." Surely explosions raise temperatures. The author's assumption results in an unsafe answer (too small an area).

[The quoted phrase was an unfortunate one and, I now realize, should have been omitted. Rigorous calculation, again, is an exacting one. To compensate for the simple approach using original temperature, I use the higher pressure in the $W'=PV/RT$ expression, as pointed out above. This yields an answer with a built-in safety factor of approximately 2. As a matter of comparison, rigorous calculation for the sample problem indicates a rupture disk of about 10 in. dia., whereas my simplified approach gives an answer of 17 in.]

Finally, the title and introduction overstate the usefulness of the article. (This Madison Ave. touch is often evident in *CE*, and I suspect the author is not to blame.) Only certain atmospheric systems above 150 F. are covered. And there should be some discussion of applicability within this range.

[There are unpredictable and exceptional possibilities connected with all reaction systems, and the methods of calculation presented in my article are not intended to cover all such situations. I look upon the article as a step in the right direction rather than as an ultimate answer to the problems of rupture disk design.]

F. F. ASSMAN
Thiokol Chemical Corp.
Trenton, N. J.

[JACK G. LOWENSTEIN]
[Food Machinery & Chemical Corp.
Baltimore, Md.]

Pro: Information Files

Sir:

In a Pro & Con letter on filing systems (Feb. 10, 1958, p. 181), Mr. Suydam ventures the opinion that "nearly all engineers maintain their own information and data files."

My observations lead to just the opposite conclusion. Too many engineers read and then discard potentially valuable material. Data and information should be filed for future needs. Here's my advice to your engineer-readers:

An engineer's personal file should contain information on a wide range of subjects—a folder-type technical encyclopedia. Regular workday activities will provide items for the technical areas of immediate interest.

If an article looks interesting, clip it—especially if reading time is not immediately available. Some publications (e.g., *Chemical Engineering*) lay out articles with a continuity that makes clipping easy. Collect reprints, advertisements, reports, booklets, instruction manuals, etc.

This material should be put into subject folders arranged alphabetically. Always remove material that is out of date because of newer information.

I started my file five years ago when I was an instrument foreman for a petrochemical manufacturer. I consider this file my personal property; therefore, I maintain the file at my home. At this time, 112 manila folders fill a large box.

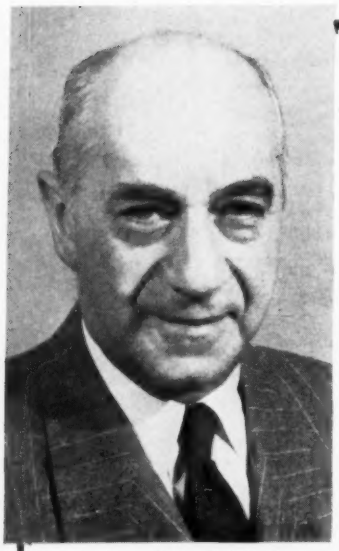
RICHARD K. KAMINSKI
Bell Aircraft Corp.
Niagara Falls, N. Y.

▶ *Mr. Kaminski provided the cartoon drawing above.*—ED.

PEOPLE...

NAMES IN THE NEWS

M. A. GIBBONS



Wilhelm Hirschkind
Dow Chemical Co.

George L. Parkhurst
Standard Oil (Calif.)

Men of the Month:

Two leading scientists—one in research, the other in administration—are honored jointly by the Pacific Chemical Exposition Award for contributions to the western chemical industry

Next Monday, April 14, the 1958 Chemical Exposition Award will go to Dow Chemical's Dr. Wilhelm Hirschkind and to Standard Oil's George L. Parkhurst—for contributions to the chemical industry in the West.

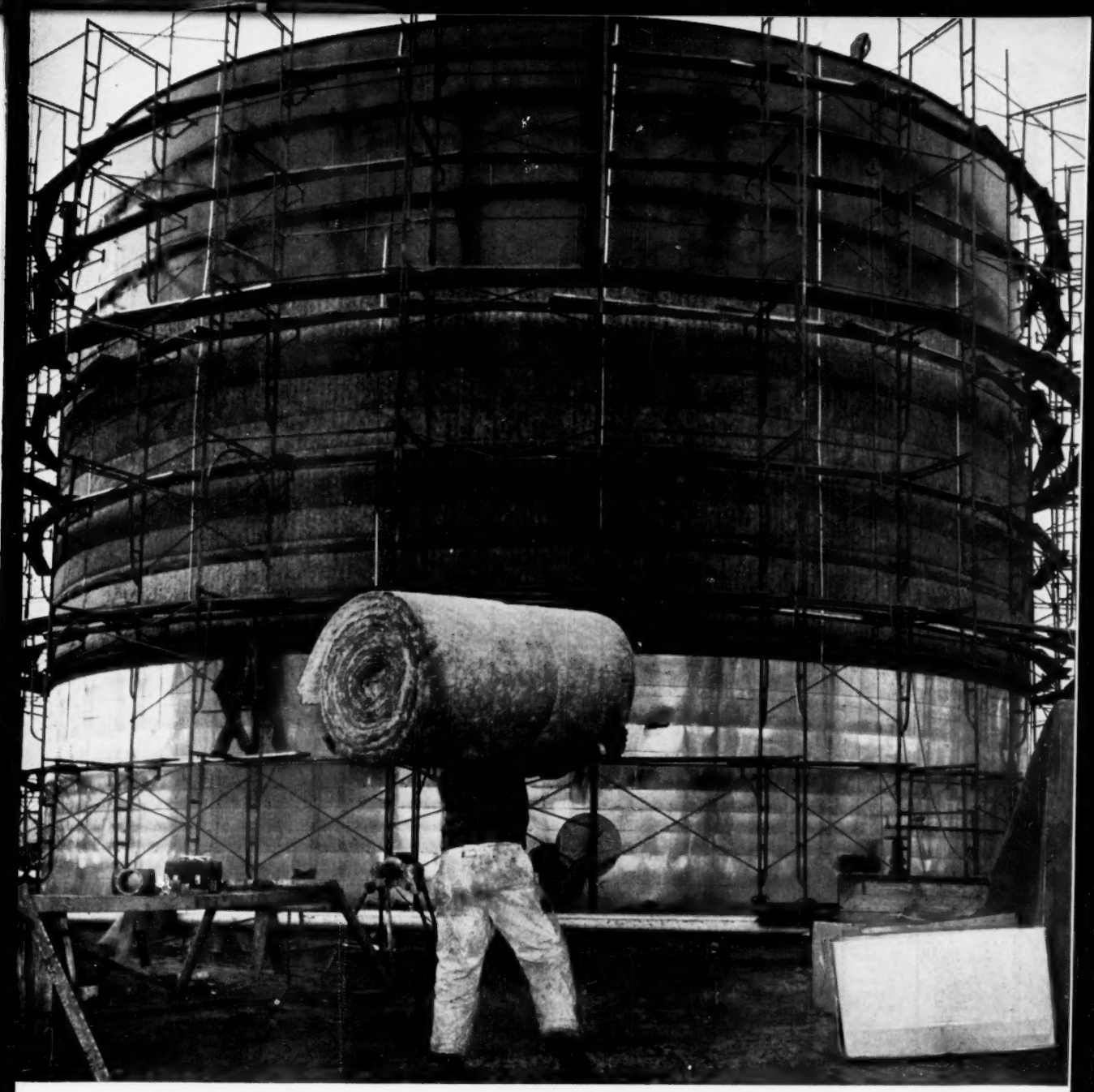
The award will be presented at a banquet, concurrent with the 133rd national meeting of the ACS in San Francisco.

Though winners of the same award, both men achieved success in the chemical field along decidedly separate paths — the one, in administration; the other, in research.

▶ **Success in Research** — The year 1909 marked a double high-point in the life of Dow Chemical's Dr. Wilhelm Hirschkind, technical advisor to the president of Dow. For, that year, Hirschkind received his doctorate in chemistry from the University of Technology Fredericiana at Karlsruhe, Germany, and—as a member of a small, elite research group in Fritz Haber's laboratory—realized the synthesis of ammonia.

But for Hirschkind, who now makes his headquarters at Dow's Western division (Pittsburg, Calif.), that was just the start of a long successful road that led from Karlsruhe to America, to the Great Western Electro-Chemical Co.—and thus to Dow.

▶ **Tangible Record**—Though his



He's carrying enough ULTRALITE to insulate 600 sq. ft. of tank!

. . . and in short order, that 600 sq. ft. roll of ULTRALITE glass fiber insulation will be permanently in place on the tank. Resilient ULTRALITE simply *wraps around* tanks, vats and vessels . . . takes only a fraction of the time required by the bat-at-a-time method. ULTRALITE "hugs" tanks closely, eliminating cracks and fluing action, and its K factor is only .27 at 70° mean temperature.

It all adds up to this: with ULTRALITE you can do a "deluxe" job—including metal weatherproofing sheets—*at no extra cost!* For details, write direct or—

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record is impressive enough on the surface, it takes on considerably more significance when you dig beneath it. Best testimonial to his efforts are several of the chemical plants now standing at several of Dow's plant sites which are the direct result of Dr. Hirschkind's accomplishments.

These days, Dr. Hirschkind is hard put to single out any one accomplishment that has excited him the most. He's understandably proud of his work in any number of fields.

Truth of the matter is that the present and the future concern him far more than the past.

For the western chemical industry, Dr. Hirschkind sees a steady growth in line with the ever-increasing population. Specifically, predicts Dr. Hirschkind, the West Coast will have a synthetic fiber and textile industry within a decade.

▶ **The Beginnings**—Dr. Hirschkind was born in 1886 in a small town near Nuremberg, Bavaria. He entered the Royal Institute of Technology at Munich in 1904 to study chemistry and later attended the University of Berlin. After receiving his doctorate in 1909 he soon became assistant superintendent at a large dyestuff works in Germany.

Some years later, he came to the United State where he has taught chemistry (at the University of Illinois), worked for the Natural Soda Products Co. and for Great Western Electro-Chemical. When the latter merged with Dow, he became director of research for Dow's Western division.

During the spring and summer of 1945, he served as investigator for Chemical Warfare Service in Europe. Work earned him the Medal of Merit from the Secretary of War.

As far as his personal life is concerned, he enjoys his ranch near Martinez, Calif., where he and Mrs. Hirschkind have lived for many years. He still rides horses well, though he admits that he has made one concession to his age: he has given up skiing.

▶ **Administrator** — Recently, George L. Parkhurst, vice president and director of Standard Oil Co. of California, mused "I

figure that I spend one night out of every nine on an airplane."

Parkhurst's remark accurately sums up an activity that now eats up a major chunk of his time—traveling between his San Francisco office and the rest of the world.

As director of the parent company, about half of his time is devoted to managing the Arabian Oil Co. and the Trans-Arabian Pipe Line Co. Work entails at least two visits a year to the overseas operations. The other half of his efforts are concerned with charting the growth of the chemicals end of Standard Oil of California's business.

▶ **Never Swamped**—On top of this, last year, Parkhurst was named chairman and chief executive officer of California Chemical Co.—newly formed holding company that coordinates all of Standard's chemical interests.

Between the two jobs, Parkhurst estimates that he has made two trips a month to New York during the last six to eight years. This is in addition to his foreign trips and travels to other parts of the nation.

The pace, though, never cramps his ability to work well and quickly.

On his first trip to Europe, for instance, Parkhurst arranged his schedule so that he could fly to London, take part in a meeting and return to New York with a total absence from his desk of just four days.

Another time, a ten-hour business session wound up after 2:30 a.m. One of those present at the meeting showed up at Parkhurst's office at 8:15 the next morning — feeling holier-than-thou about his early return to work. As he entered the office, though, Parkhurst's secretary was busy typing a 14-page report, which had been polished off in the few intervening hours. Questioned about it, Parkhurst said simply that he never allowed a day's work to hang over.

There's a story, too, about another side of Parkhurst's personality. In the early days when he lived in Gary, Ind., he frequently took the last bus home from Chicago or Whiting. During these trips, he was known to drive the bus so that the regular driver could rest.

NAMES . . .

► **Background**—Born in Evanston, Ill., in 1907, Parkhurst received his degree in chemical engineering from Armour Institute of Technology in 1927. That year, he began his industrial career with Standard.

Over the years, he earned a law degree from DePaul University, did graduate work in chemistry at the University of Chicago and studied accounting at Northwestern and Wharton.

During World War II, he acted as assistant director of refining in the Petroleum Administration for War. In 1945, he joined Oronite Chemical as vice president and moved up to the presidency the following year.

Ernest P. Miller

Ernest P. Miller, of Cameron and Jones, consulting engineers, Denver, Colo., has begun an 18-month assignment for Petroleo Brasileiro S/A (Petrobras), Brazilian National Oil Co. He will be concerned with the petrochemicals development program of the company.

Before joining Cameron and Jones in 1956, Miller worked for Pure Oil Co., U. S. Bureau of Mines and Celanese Corp.

At Pure Oil, Miller served as pilot-plant group leader and worked with the refinery control board of the company. With the Bureau of Mines, he did design and process evaluation work involving oil shale and coal.

At Celanese, Miller was staff process-evaluation engineer, making economic analyses of new processes and products, plant expansions for the textile, chemical and plastic divisions of the company. His main field at Cameron and Jones is process economics.

John W. Benedict

John W. Benedict has been appointed sales manager for Girdler catalysts in the chemical products division of National Cylinder Gas Co. With headquarters in Louisville, he will be in charge of an expanded sales program in the field of specialty catalysts to the chemical, plastics, petroleum, food and other industries.

For the past seven years Benedict has held various sales assignments with the petroleum catalysts department of Davison Chemical Co. Early in World War II, he served as a research engineer at the Mellon Institute of Industrial Research where he worked on methods of analyzing and purifying butadiene.

After wartime military service, Benedict was employed for four years as a member of Texas Co.'s process engineering group with responsibility for process development and plant balance and start-up projects.

Ashley S. Campbell, former dean of the College of Technology at the University of Maine, has been named recipient of the eighth annual Honor Award presented by the University of Maine Pulp and Paper Foundation.

L. William Kates has been appointed director of engineering of Sylvania-Corning Nuclear Corp.

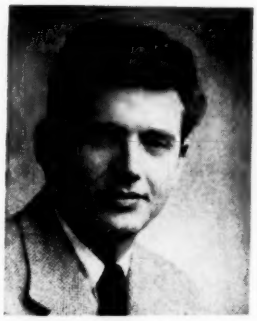
Raymond J. Kenard, Jr. has been named sales representative in Selas Corp. of America's Los Angeles sales district.

John P. Bainbridge, Jr., formerly associated with Mon-

NAMES . . .

santo Chemical Co., has joined Penick & Ford, Ltd. as assistant sales service manager to J. E. Killinger. Bainbridge's headquarters will be at Cedar Rapids, Iowa.

Walter L. Bass has rejoined Rust Engineer Co. as assistant to the vice president, engineering. For the past three years, Bass had been in Paris, France, as a project manager for Lummus Co. where he was responsible for design and construction of a new oil refinery in Finland. Before that he was a chemical process engineer with Rust in Pittsburgh.



T. Peter Forbath

When Pete Forbath stepped out of his little blue VW in Chicago last week it was that city's gain and New York's loss. More specifically, though, it meant the loss to our readers of a good writer here on the New York staff and the addition of a mighty fine reporter in the field.

A chemical engineer—Brooklyn-Poly style—Pete is a whiz in his field and top-notch producer of copy besides.

After graduation from school in June 1953, Pete spent six months in California working for North American Aviation Corp. Then, his local draft board took over and Pete was fortunate enough to do his stint in Europe. Bulk of it was spent at an air base near London (with periodic vacations on the Continent).

When he was discharged, early in 1956, Pete joined the *Chemical Engineering* staff as an editorial assistant. Since that time, he has polished off scores of

tedious flowsheets and innumerable featurettes for Processes & Technology.

Here on the New York staff, we'll miss Pete's familiar trench coat and easy smile but we're sure that readers and authors in the Chicago area will find him a welcome addition to the windy city.

John A. King

The developments group of *Chemical Engineering's* editorial staff has taken on a new editorial assistant in the person of John King. He'll report to Cecil H. Chilton—head of the group.

John studied mechanical engineering for a year at Stevens Institute of Technology, under *CE's* Steve Danatos. Later, he switched (but not entirely because of Steve) to Brooklyn Poly and chemical engineering. He got his degree from Poly in June 1957 and, since that time, has also taken a human relations course at Lafayette College.

At Poly, John was assistant editor of *Packed Columns*, the chemical engineering publication and assistant advertising manager of the school publication. He also worked on the yearbook, was vice president of the Intervarsity Christian Club and was active in the AIChE chapter.

John's work experience includes technical service with Socony Mobil Oil, industrial engineering at Sunshine Biscuit Co., and production supervision at J. T. Baker Chemical Co., Phillipsburg, N. J. John has also been a part-time consultant to Chemtron Corp., manufacturers of chlorinated wax, on process development design.

Memberships include the AIChE, the Easton Area Indus-

trial Management Club and the Lehigh Valley Chemical Engineers Club. John's special interests are: Hi-fi, photography, books, music and sports cars.

Oka Carlson

Appointment of Oka Carlson as manager of its new plastics plant at Apple Grove, W. Va., has been announced by Goodyear Tire & Rubber Co.

Carlson will be headquartered in Akron until the $9 million installation goes into production early in 1959. When completed, the Apple Grove unit will produce Videne, Goodyear's new polyester film.

Carlson has been with Goodyear since 1941, serving in various capacities. Most recently he was superintendent of cascade (production) operations at Goodyear Atomic Corp., Portsmouth, Ohio. Earlier he was division superintendent of extruded goods at the new St. Marys plant in Ohio; division superintendent of tank tracks and extruded goods at Goodyear's Muncie, Ind., plant.

L. F. "Tink" Doyle has been appointed sales engineer for the chemical materials division of E. V. Roberts & Associates, Los Angeles. Doyle was formerly with Furane Plastics, Glendale, Calif., as sales and product development engineer.

Everett J. Collier recently joined the development department of the overseas division of Procter & Gamble. **E. Harry Brown** has joined P & G's development department of the soap products division.

George H. Stram

George H. Stram has been appointed chief engineer of chemical equipment of Read Standard Division, Capitol Products Corp., York, Pa.

Most recently, Stram headed his own engineering organization. Prior to that he was chief engineer of the sprayer department for the York division of Oliver Corp.

Stram has served on various industrial and governmental committees on construction and development of agricultural and chemical equipment, including chairmanship of the governmental Committee on Pesticide and Application Equipment.

H. Wesley Hibbert, formerly executive vice president, has been named president of Pecora, Inc., manufacturer of calking compounds, tile adhesives and other products for the building trade.

E. F. Greiwe has been appointed manager of the Norwood Works centrifugal pump department, Allis-Chalmers. He succeeds M. L. Murdock, resigned.

John R. Eck has been elected president of Mobay Chemical Co. Eck, assistant general manager of Monsanto's inorganic chemicals division for the past five months, succeeds D. L. Eynon, Jr., who is now vice president of Kopper Co. and general manager of that company's plastics division.

Matthew S. McCauley, director of business research for Monsanto Chemical Co.'s organic chemicals division in St.

NAMES . . .

Louis, Mo., has been appointed director of marketing research for the division.

George B. Shearon has joined the phosphate chemical division, International Minerals & Chemical Corp., as a process engineer at its Bonnie, Fla., plant.

David L. Eynon, Jr.

David L. Eynon, Jr., president of Mobay Chemical Co. for the last four years, has resigned that post to become vice president and general manager of Koppers Co.'s newly formed plastics division.

Eynon, a graduate of both Williams College and M. I. T., joined Monsanto Chemical Co.'s research department in 1933. Since then he has had positions of increasing responsibility, including those of superintendent of the acid department; plant manager of the Monsanto-operated Longhorn Ordnance Works, Marshall, Tex.; assistant general manager of Monsanto's organic chemicals division.

In 1954 he was named president and a director of Mobay Chemical Co., jointly owned by Monsanto and Bayer.

Miro A. Grottger, chemical engineer of Morristown, Pa., has joined Industrial Finishes Co., Philadelphia, as vice president and director of research.

Robert H. Ostrander has been named manager of sales development for Gallowhur Chemical Corp. **Henry H. Taylor** has been named product manager for the organiza-

tion's textile chemical division.

James M. Stevenson has been appointed sales manager of vacuum melted products of the metallurgical products department, General Electric Co., Detroit.

Lewis H. Conklin has been appointed senior technical man at the B. F. Goodrich Chemical Co. development center at Avon Lake, Ohio.

Malcolm A. Weiss has been appointed head of the production research section, a newly created unit in the process research division of Esso Research and Engineering Co. Prior to his appointment, Weiss was assistant head of his division's cracking section.

Bernard H. Jacobson

In recognition of his pioneering work in the development of plasticizers for vinyl resins and related products, Bernard H. Jacobson, vice president and director of Food Machinery and Chemical Corp., has received the 1958 Honor Award of the Commercial Chemical Development Association.

Jacobson, upon graduation from Lehigh University in 1917, joined Hooker Electrochemical Corp. He moved to E. C. Klipstein & Sons Co., Charleston, W. Va., in 1921 where he developed a commercial process for making pure anhydrous aluminum chloride, essential in making anthraquinone. In 1927 he was promoted to plant manager and continued in that post when

Klipstein was taken over by American Cyanamid.

In 1936 Jacobson joined Ohio-Apex as general manager and rapidly established the company as a commercial supplier of plasticizers for use with vinyl resins. His pursuit of an intensive development program resulted in the first commercial process to make dioctyl phthalate (DOP).

In 1951 Jacobson was elected vice president and director of the parent company. He now devotes full time as business consultant and technical advisor to the corporation's chemical groups.

Robert S. Parkins

General Tire & Rubber Co. has announced the appointment of Robert S. Parkins as staff development engineer of its chemical division.

Parkins received both his bachelor's and master's degrees in chemical engineering from the University of Colorado. Formerly assigned to General Tire's Ashtabula chemical plant as senior process engineer, he joined the organization in 1954. In his previous position he was process engineer for General Electric Co.

OBITUARIES

Lee A. Keane, retired vice president of U. S. Industrial Chemicals Co., died February 7 at his home in New Canaan, Conn. He was 63 years old.

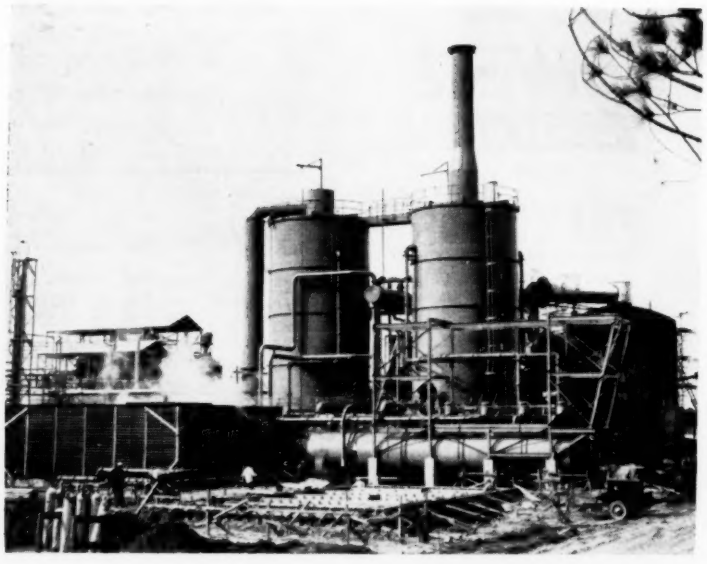
Albert A. Scharwachter, 61, executive vice president of Arizona Chemical Co., was killed in an accident that occurred in Winter Park, Fla., on February 14.

PEOPLE . . .

FIRMS IN THE NEWS

R. A. LABINE

NEW FACILITIES



$6.5-Million Fertilizer Unit Swings on Stream

The sulfuric acid unit at Coastal Chemical Corp.'s new fertilizer plant at Pascagoula, Miss., sports what is probably world's biggest single sulfur burner (capacity—600 tons/day H_2SO_4). Plant makes wet phosphoric acid via St. Gobain process, can produce 350 tons/day ammonium phosphate.

Pennsalt Chemicals Corp. has entered another phase of the missile fuel field with its announcement that it will erect an ammonium perchlorate plant adjacent to its sodium chlorate plant at Portland, Ore.

Wyandotte Chemicals Corp. has just placed on stream at Wyandotte, Mich., the first unit for commercial production of methylpyrazine and 2,5-dimethylpyrazine.

Koppers Co. is shaping up plans for another expansion of its polyethylene plant at Port Arthur, Tex. Expected to double plant's capacity, new plans follow hard on heels of a 20% expansion just being completed.

Allied Chemical's General Chemical Div. has started construction on a new hydrofluoric acid plant at Nitro, W. Va., to supply the metal and other industries in the area.

United-Heckathorn Co., Richmond, Calif., is planning to build a $250,000 synthetic cryolite plant in the Garfield, Utah area. Proposed capacity is 3,000 tons/yr. via a new and still-secret process.

Boise Cascade Corp. has selected Swinerton & Walberg Co. of San Francisco to erect its $15-million pulp and paper mill at Wallula, Wash. Work is expected to be completed within a year.

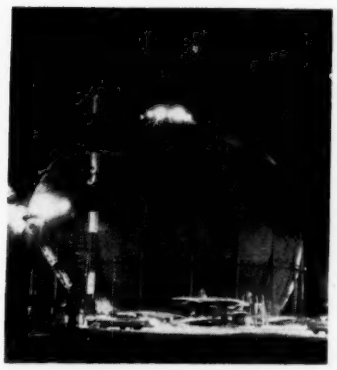
Du Pont plans to build a new unit for manufacturing two new polyvinyl acetate emulsions at the Toledo, Ohio,

plant of the electrochemicals department. The new unit is expected to be in operation by next December.

Linde Co. will start construction in June on an automated oxygen unit at the Portsmouth, Ohio, plant of Detroit Steel Corp. When completed by end of this year, unit is expected to produce 20 million cu. ft./mo. oxygen.

Sherwin-Williams Co. has construction underway on new facilities for manufacture of high-grade barium monohydrate at Coffeyville, Kan. Using a patent-applied-for process, firm will produce 99% pure monohydrate directly from baryates ore; operation is slated for this fall.

Staley Mfg. Co., corn and soybean processor, announces plans for a new three-story pilot plant annex to expand process development work at its Decatur, Ill., plant.



Chicago Bridge & Iron Co. has its night crew working on a 190-ft.-dia. Hortonsphere that will house the atomic reactor for the Dresden Nuclear Power Station near Chicago.

National Tank & Boiler Co. is doubling its manufacturing space with the construction of a 30,000-sq.-ft. metal fabrication plant in the Hazelwood-Berkeley industrial area near St. Louis, Mo.

Stoner-Mudge Co., protective coatings maker, has added a

FIRMS . . .

3-story laboratory wing to its headquarters building in Pittsburgh, Pa., doubling research facilities.

Farmers Liquid Fertilizer Co. recently brought into production its new plant at Patterson, Ark., for manufacture of liquid fertilizers.

Pennsylvania Industrial Chemical Corp. has started up its new highly automated plant for production of hydrocarbon resins and aromatic solvents at West Elizabeth, Pa.

Geigy Chemical Corp. has broken ground in Ardsley, N. Y., for a 37,000-sq.-ft. laboratory that will be devoted to basic pharmaceutical research.

Corn Products Refining Co. has awarded to Walter Kidde Constructors a $2-million contract for the design, engineering and construction of a corn processing plant to be erected in Cali, Columbia.

Graver Tank & Mfg. Co. has been awarded the enclosure-shell contract for the AEC's experimental breeder reactor to be built at the National Reactor Testing Sta. near Idaho Falls, Idaho. The vessel will be of 1-in. steel, 80 ft. wide and 139 ft. high.

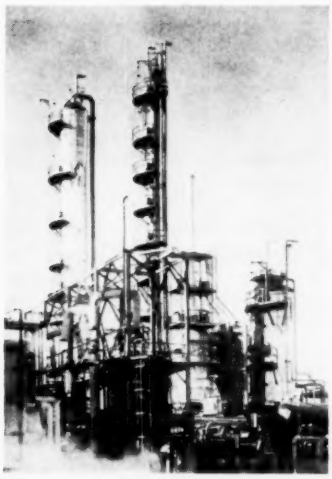
Chemical Process Co. has completed construction of expanded facilities for manu-

facturing Dion resinous adhesives at Redwood City, Calif.

Allis-Chalmers will erect a new engineering, development and research laboratories on a 30-acre site near Milwaukee, Wis. The initial building will have 23,000 sq. ft. of laboratory space.

American Chrome Co. is starting construction of a high-carbon ferro chrome pilot plant at Nye, Mont. Initial production wil be 5 tons/day with a later boost to 15 tons/day.

American Bitumuls & Asphalt Co., subsidiary of Standard Oil of California, is constructing a new bitumuls emulsified asphalt plant at Standard's Richmond Beach plant north of Seattle, Wash. New unit is slated to go into production around May 1.



Esso Standard Oil is operating a new 7,200-bbl./day Powerforming unit at its Everett, Mass. refinery. Built by Badger Mfg. Co., facilities had to be erected on "stilts"—concrete pilings driven deep into area's marshy tidelands.

Parke-Davis has chosen Barton-Malow Co. of Detroit as general contractor for firm's new medical research laboratories near Ann Arbor, Mich. When completed early in 1960, fa-

FIRMS . . .

cilities will house 400 employees.

Hooker Electrochemical's new $3.5-million research center at Niagara Falls, N. Y., is well underway. Wigton-Abbott Corp. is handling engineering and construction.

U. S. Rubber Co.'s North British Rubber Co. subsidiary has started construction of a new 145,000-sq-ft. hose factory in Edinburgh, Scotland, that is a major part of the firm's $8.5-million modernization program.

Ethicon, Inc., Somerville, N. J., has installed a linear accelerator at its plant and is using it for sterilization of a major portion of its surgical products.

Bound Brook Oil-Less Bearing Co. is building a manufacturing plant in Sturgis, Mich. for production of self-lubricated sintered bearings.

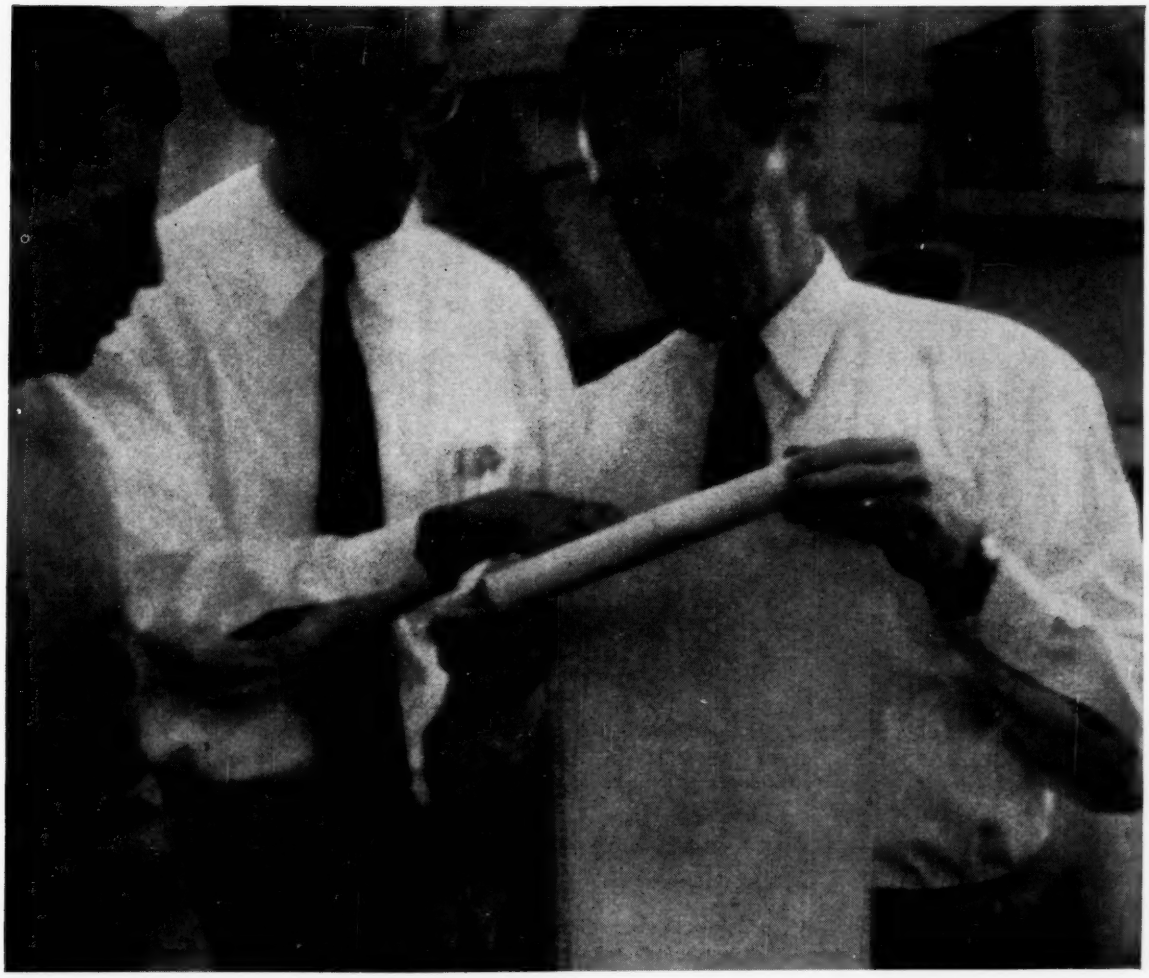
M. W. Kellogg is providing process, design engineering and procurement for a 24,000-bbl./day expansion of the Concon, Chile, refinery of Empresa Nacional Del Petroleo.

Canadian Industries Ltd.'s new hydrogen peroxide plant has swung on stream at Hamilton, Ont., using the Becco electrolytic process.

Socony Mobil Oil Co. has announced plans for a $28-million refinery to be erected near Puerto Cabello, Venezuela. The 40,000-bbl./day installation is scheduled for completion late in 1959.

Solvay Process Div., Allied Chemical & Dye Corp., has completed a new dense soda ash plant at Baton Rouge, La., doubling plant's previous capacity.

Walmet Corp., Detroit, Mich., is installing a large new ball mill for blending high-priced metals in powder form. With capacity of 800 lb., unit will handle cobalt powder and car-



Time for a look at process economies?

Faced with stiffer competition and climbing operating costs, more and more process engineers are finding that L&N precision analytical equipment "pays off" in savings . . . by increasing process efficiency and product yield.

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Air Pollution Monitoring—*with the preferred Thomas Autometer.*

For further information on L&N equipment for chemical, petroleum and allied industries, talk to the men at our nearest office, or write to Leeds and Northrup Co., 4916 Stenton Ave., Phila. 44, Penna.

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FIRMS . . .

bides of tungsten, titanium and tantalum; boosts production by 30%.

B. C. Forest is now checking out equipment preparing to start up its new $46-million bleached sulfate pulp mill at Crofton, B. C. Full-scale production is scheduled for early spring.

NEW LOCATIONS

Sun Chemical Corp. has moved its headquarters to 750 Third Ave., New York 17, N. Y.

F. J. Stokes of Canada, Canadian subsidiary of F. J. Stokes Corp. of Philadelphia, has moved its Toronto headquarters to 4198 Dundas St. West.

Water Service Laboratories, specialists in corrosion control, has moved its Philadelphia offices and laboratories to 169 W. Wyoming Ave.

Babcock & Wilcox Co.'s Charlotte, N. C., district sales office has been moved to 1100 Wachovia Bank Bldg., 129 Trade St., Charlotte 2.

Kennedy-Van Saun Mfg. & Engineering Corp. of Danville, Pa., has relocated its New York headquarters at 405 Park Ave., New York City.

NEW LINES

Foster Grant Co. is now in production of high-impact styrene product called Fosta Tuf-Flex in a new $1-million plant at Leominster, Mass.

Continental Can Co. has developed a metallized paper for carton overwraps and for can and bottle labels. First com-

TONNAGE MOLYBDENUM CHEMICALS

To Precise Specifications

AMMONIUM MOLYBDATE, REAGENT

$(NH_4)_6Mo_7O_{24}.4H_2O$ F.W. 1235.95

Meets A.C.S. Specifications

Assay (as MoO_3)	81.0-83.0%
Insoluble Matter	0.005 % Max.
Chloride (Cl)	0.001 % Max.
Nitrate (NO_3)	0.003 % Max.
Phosphate (PO_4)	0.0005 % Max.
Sulfate (SO_4)	0.005 % Max.
Heavy Metals (as Pb)	0.001 % Max.
Magnesium and Allied Cations	0.020 % Max.
pH of 5% Solution at 25°C	5.0-5.5

Particle Size (Mesh): at least 95% thru U.S. No. 20 Sieve
at least 90% on U.S. No. 140 Sieve

AMMONIUM MOLYBDATE, C.P.

$(NH_4)_6Mo_7O_{24}.4H_2O$ F.W. 1235.95

Assay (as MoO_3)	81.0-83.0%
Insoluble Matter	0.010 % Max.
Chloride (Cl)	0.005 % Max.
Nitrate (NO_3)	0.010 % Max.
Phosphate (PO_4)	0.001 % Max.
Sulfate (SO_4)	0.010 % Max.
Heavy Metals (as Pb)	0.003 % Max.
pH of 5% Solution at 25°C	5.0-5.5

Particle Size (Mesh): at least 95% thru U.S. No. 20 Sieve
at least 90% on U.S. No. 140 Sieve

SODIUM MOLYBDATE, TECH. ANHYD.

Na_2MoO_4 F.W. 205.93

Assay (Na_2MoO_4)	98.0 % Min.
Insoluble Matter	0.050% Max.
Chloride (Cl)	0.20 % Max.
Sulfate (SO_4)	0.20 % Max.
pH of 5% Solution at 25°C	9.0-10.0

MOLYBDIC ACID, PURIFIED

Min. 84% MoO_3

Assay (as MoO_3)	84.0-86.0 %
Insoluble in NH_4OH	0.020 % Max.
Chloride (Cl)	0.002 % Max.
Phosphate (PO_4)	0.0005% Max.
Sulfate (SO_4)	0.020 % Max.
Heavy Metals (as Pb)	0.005 % Max.

Particle Size (Mesh): at least 97% thru U.S. No. 40 Sieve
at least 10% thru U.S. No. 325 Sieve

MOLYBDENUM TRIOXIDE, REAGENT

MoO_3 F.W. 143.95

Meets A.C.S. Specifications

Assay (MoO_3)	99.5 % Min.
Insoluble in NH_4OH	0.005 % Max.
Chloride (Cl)	0.002 % Max.
Nitrate (NO_3)	0.003 % Max.
Phosphate (PO_4)	0.0005% Max.
Sulfate (SO_4)	0.020 % Max.
Ammonium (NH_4)	0.001 % Max.
Heavy Metals (as Pb)	0.005 % Max.

Particle Size (Mesh): at least 90% thru U.S. No. 40 Sieve
at least 10% thru U.S. No. 325 Sieve

USES

Molybdenum compounds are widely used in the production of catalysts, phosphomolybdic-phosphotungstic lake colors, molybdate chrome orange pigments, protective and decorative metal finishes, soil additives, and pure molybdenum metal for radio tubes, X-ray tubes, and incandescent lamps. They have specific uses in pharmaceutical, leather and textile manufacture.

In addition to above mentioned Molybdenum Chemicals, Baker also supplies several other Molybdenum Chemicals for industrial use.

Technical product data, samples, and prices will gladly be forwarded upon request.

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J. T. Baker Chemical Co.
Phillipsburg, New Jersey

J.T.Baker CHEMICALS

mercial package applications are being studied.

Tube Turns Plastic, Louisville, Ky., has replaced its existing line of smooth-face flanges with a complete line of flanges having concentric-serrated faces for PVC piping systems.

Catalin Corp. of America has just made available 14 chemical intermediates and specialties resulting from stepped-up research effort. Included are chemicals used in pharmaceuticals, soaps, dyestuffs and fungicides.

Celanese Corp. of America has started commercial production of a new type of rigid polyethylene. Called Fortiflex A-20, material is said to have high strength, resistance to stress cracking and to have an unusually low melt index. In picture, strands flow through water bath prior to being chopped into pellets.

Monsanto Chemical Co. has entered the naval stores field with the purchase of the physical assets of Filtered Rosin Products of Baxley, Ga., manufacturer of paper size and other gum rosin items.

Yuba Consolidated Industries has acquired Dynalysis De-

Using Salt Efficiently

by INTERNATIONAL SALT COMPANY, INC.

Hydraulic Handling—Quick, Economical Way to Move Salt into Storage

Here's a new, effective method for moving salt from delivery cars or trucks into plant storage, without disrupting other operations. Hydraulic Handling systems, already in operation in several plants, have eliminated the expense of mechanical unloading equipment, and cut down considerably on man-hours needed to do the job.

What is Hydraulic Handling? Very simply, Hydraulic Handling is the movement of granular salt in circulating saturated brine, through pipes. Referring to the diagram, you will note that dry salt from the hopper car is mixed with saturated brine in a salt-receiving pit, to form a slurry of the saturated brine and undissolved salt. This slurry is pumped through a pipe to a salt-storage tank. Overflow brine from the tank continuously returns to the slurrying pit to carry more salt into storage.

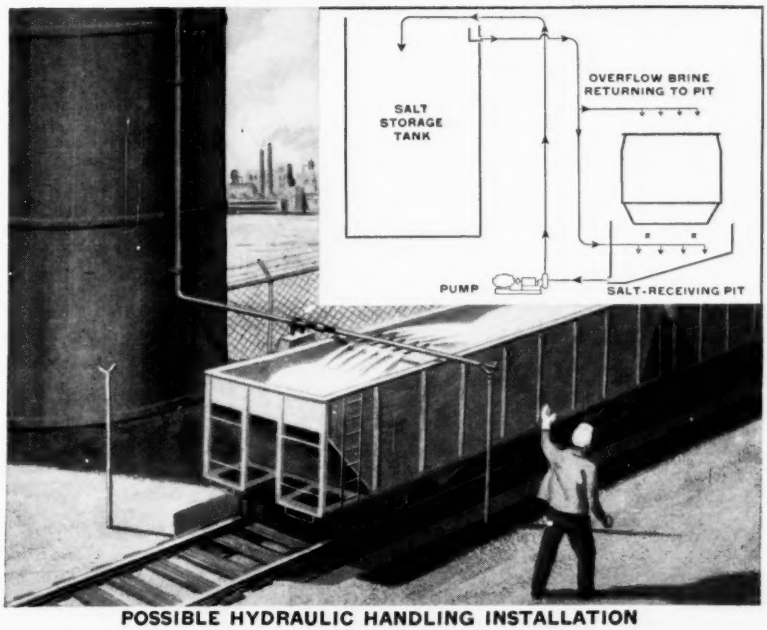
Advantages of Hydraulic Handling. Every Hydraulic Handling installation has a number of exclusive advantages:

1. Great flexibility. Because *pipes* do the work of carrying salt, a Hydraulic Handling system can be installed anywhere in the plant. Piping is flexible, and can be run where it won't interfere with other plant operating activities.

2. No need to move existing equipment. Machines that might obstruct mechanical handling equipment simply don't get in the way of a Hydraulic Handling installation.

3. Long life, low maintenance. You need no safety guards . . . no roofing to protect salt from weather . . . no belt conveyors, elevators or similar pieces of mechanical handling equipment. Also, there is never any salt dust that might corrode vital plant equipment. As a result, Hydraulic Handling installations have a long life, with very little maintenance expense.

4. Unlimited capacity. Hydraulic Handling systems can be designed to unload, move and store any amount and type of salt—rock or evaporated. Whatever your specific unloading needs, Hydraulic Handling can satisfy them.



POSSIBLE HYDRAULIC HANDLING INSTALLATION

For rock-salt users, Hydraulic Handling is especially economical when used with combined wet-storage and dissolving tanks or with International Salt Company's famous Sterling Wet-Storage Lixator. These units store Sterling Rock Salt the same way Hydraulic Handling moves it: combined with saturated brine. Thus the salt-and-brine slurry delivered through Hydraulic Handling to the Lixator *is already in the correct form.* The Lixator delivers 100%-saturated Lixate Brine through pipes to any point of use in the plant, and automatically makes more brine as needed.

From delivery to use, dry rock salt is never handled in plants equipped with both a Hydraulic Handling system and a Sterling Lixator.

You can get more information on how Hydraulic Handling can work in your plant to cut down salt-unloading and salt-handling expense from International Salt Company. One of our experienced Sales Engineers will be glad to work with you to determine the best system of Hydraulic Handling for your specific needs. He can also help you use salt efficiently in *all* your plant operations needing salt or brine.

Behind this qualified salt specialist are all the resources and experience of International Salt Company. We produce both Sterling Rock Salt and Sterling Evaporated Salt in all types and sizes . . . plus automatic equipment for making brine from both kinds of salt. So our sales engineer can recommend the type and size of salt most perfectly suited to your needs. He can also recommend the most efficient and inexpensive methods for storing, handling or using salt or brine. Ask him . . . send a card or letter to International Salt Company, Inc., Scranton 2, Pa. . . . or contact our nearest sales office.

INTERNATIONAL SALT CO., SCRANTON, PA.

Sales Offices: Atlanta, Ga.; Chicago, Ill.; New Orleans, La.; Baltimore, Md.; Boston, Mass.; Detroit, Mich.; St. Louis, Mo.; Newark, N. J.; Buffalo, N. Y.; New York, N. Y.; Cincinnati, O.; Cleveland, O.; Philadelphia, Pa.; Pittsburgh, Pa.; Memphis, Tenn; and Richmond, Va.

Service and Research are the Extras in **STERLING SALT**

PRODUCT OF INTERNATIONAL SALT COMPANY, INC.

FIRMS . . .

velopment Laboratories, a Los Angeles designer and manufacturer of electro-mechanical missile systems.

Pudget Sound Pulp & Timber Co. and the Pacific Coast Paper Mills of Washington will merge their operations at Bellingham, Wash., if stockholders approve the plan announced recently.

Morningstar-Paisley has acquired two firms recently, bringing about a substantial addition to its line of starch, resin and chemical offerings to the paper industry. Added were: Haberland Mfg. Co. and Federal Adhesives Corp.

Lawter Chemicals, Inc., of Chicago has purchased the name, assets and good will of Krumbhaar Chemicals, South Kearney, N. J. Krumbhaar will continue to operate under its old name.

Schenley Industries has bought a substantial stock interest in Radiation Applications, Inc., which is active in atomic energy, chemicals, metallurgy and aerosol technology.

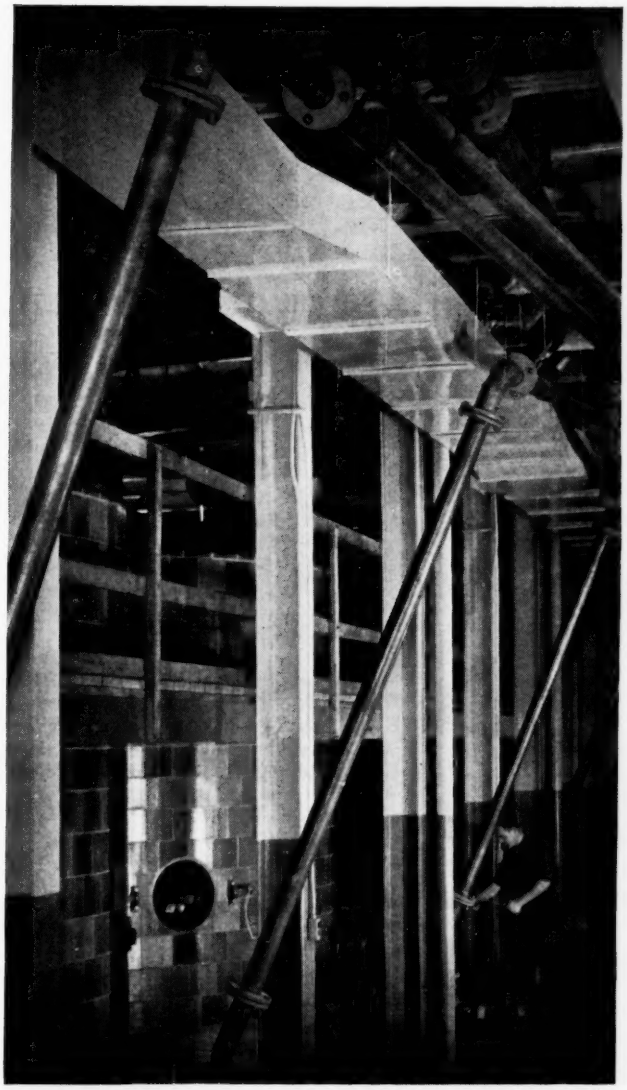
Thiokol Chemical Corp. is planning to purchase the principle assets of the Hunter-Bristol Corp. of Bristol, Pa., expanding Thiokol's interests in rocket-aircraft field. Agreement is subject to approval of Hunter-Bristol stockholders.

Stone & Webster Engineering Corp., in a move to broaden its activities in the nuclear field, has acquired Associated Nucleonics, Inc., of Garden City, L. I.

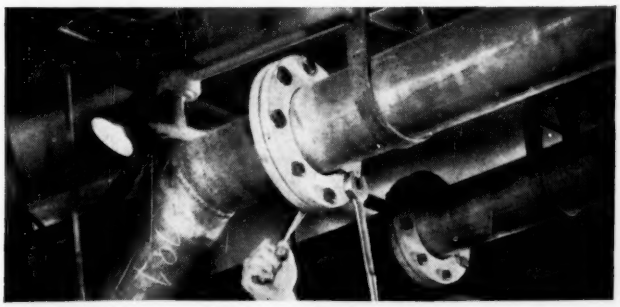
Commercial Filters Corp., subsidiary of Ogden Corp., has acquired branch offices and warehouses of W. A. Case & Son Mfg. Co. in Niagara Falls, Buffalo, Rochester, Syracuse, Olean and Jamestown, New York.

Mandrel Industries has acquired Sequoia Wire Co. of Redwood City, Calif., manufacturer of wire and cable

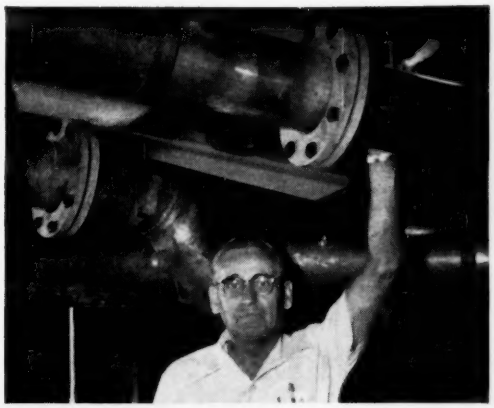
Copper tube for pipe lines cuts installation time 40% —gives superior service in paper pulp handling



COPPER TUBE USED to transmit paper pulp in the Crocker, Burbank & Co., Mill #5 at Fitchburg, Mass.



LARGE-DIAMETER copper tubes are joined by welding (note elbow) or by the flange type of connection.



WILLIAM G. DUNN of Crocker, Burbank & Co. says copper tubes for the process lines in paper-making plants offer many advantages over other piping materials. He uses Anaconda Copper Tube in sizes up to 10" I.D.

"Easy handling and installation are the biggest advantages of copper tube in our operation," says William G. Dunn, supervisor of sheet metal and piping for Crocker, Burbank & Co., paper manufacturers of Fitchburg, Mass.

"We estimate that copper saves us about 40% in installation time. Just the advantage of standard 20-foot lengths greatly simplifies our job, when you consider that we have runs up to 365 feet long. Also, because of the relatively light weight of copper tubes, we can do more fabrication and preassembly in our pipe shop than would be practical with heavier piping."

Meets corrosion problems. Copper tube lines are used to transmit paper pulp from beaters to pulp storage tanks and on to work boxes at the paper machine. In this service, copper does not contaminate the pulp and resists corrosion from the pulp solutions. Copper tube is also used to carry deionized water used in the paper-making process.

Your requirements. No matter how special your piping problems may be, it is quite possible that Anaconda seamless tubes may provide the solution. The American Brass Company offers the widest range of sizes in copper and copper alloys available to industry—from .032" O.D. to 26.875" O.D. Technical assistance is also available to help you determine the alloy best suited to meet your requirements. For such help or further information about Anaconda products, contact our nearest District Sales Office or write to: The American Brass Company, Waterbury 20, Conn.

5790

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in Copper, Everdur®, Cupro Nickel, Brass

Made by

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products for communications, aircraft and electronics industries.

American Petrofina is purchasing all major oil and gas holdings formerly owned by Atlas Corp.

NEW NAMES

Cleveland Fuel Equipment Co. has changed its name to Cleveland Controls, Inc., to better describe firm's products and projects.

North American Cyanamid, Ltd., has changed its name to Cyanamid of Canada and will establish headquarters in Montreal.

Mallory-Sharon Metals Corp., formerly Mallory-Sharon Titanium Corp., has been officially reorganized. Company, with plants in Niles and Ashtabula, Ohio, assumes new name to reflect expansion into zirconium and other special metals.

Hytron, Inc., fabricator of fluorocarbon products for missile, aircraft and other industries, is now known as Lefco Products, Inc.

NEW COMPANIES

HEF, Inc., has been formed jointly by Hooker Electrochemical Co. and Foote Mineral Co. to specialize in manufacture of solid-fuel components for rockets and guided missiles.

Haydon Instrument Co., Waterbury, Conn., is a new company specializing in design and manufacture of electromechanical devices.

Standouts for Splash Protection!

157 Chemical Shield

Here's engineered protection for the head, face and neck against hazardous chemical splashes. Unit consists of American Optical's H-5 vulcanized headgear, a rear drape and front bib of acid resistant neoprene and a clear acetate window ($18\frac{1}{4}''$ x $10''$ x .040" thickness). Note the full crown deflector — quick fastening studs along front and end clips keep window secure.

Snap fasteners along rear edge and at rear corners of deflector hold shoulder-length neoprene drape which fits snugly and encloses back of neck. Acid resistant neoprene bib attaches to lower edge of acetate window and extends well down chest — protects against splashes entering under window. Your nearest AO Safety Products Representative can supply you.

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In Aprons 25% more tear strength . . . 30%-40% more abrasion resistance . . . 25% more chemical resistance. 100% neoprene saturated. All stitching covered with Neoprene Latex. Every apron has solid brass grommets reinforced through 2 thicknesses of material at waist. Lightweight for comfort . . . flexible . . . easy to launder. Available in several lengths, regular and split leg types.

142 DCP
Neoprene Apron
42" Long

In Gloves Completely waterproof, dirtproof, oil, grease and solvent resistant. Rugged, durable yet comfortable and flexible with fully curved fingers and thumb. 6 models. Rigid quality controls and tests for tensile strength, elongation and durability assure you of uniform high quality — cut your handling costs.

780
Neoprene Glove
12" Overall

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.it's alloyed to resist corrosion and high temperature

DURASPUN Pipe comes in a wide range, as follows:

Outside Diameter	Minimum Wall	Length
2½" to 3"	1/4"	88" maximum
3" to 6" Inclusive	5/16"	110" maximum
Over 6" to 12" Inclusive	3/8"	168" maximum, 24" minimum
Over 12" to 14" Inclusive	7/16"	168" maximum, 24" minimum
Over 14" to 20" Inclusive	1/2"	180" maximum, 48" minimum
Over 20" to 24" Inclusive	1/2"	88" maximum
Over 24" to 32" Inclusive	5/8"	80" maximum

This is standard piping. Special cylindrical shapes in comparable high alloy steel can be cast centrifugally . . . retorts, furnaces, fractionaters and other such equipment come in this class.

Write us about your requirements. Our metallurgists backed by thirty-five years of experience will be glad to help select the best combination of alloying elements to take care of your operating conditions.

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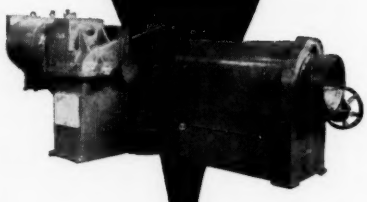

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DEWATERING Applications

Dryers

Solvent extraction equipment

Solvent recovery systems

The French Oil Mill Machinery Co. has specialized in extraction machinery for the oil milling industry for over 50 years with an outstanding record of achievement.

This experience in the profitable handling of extraction problems is now available to the chemical industry. Write today for suggestions on the most profitable method of handling extraction or de-watering.

FO17

THE FRENCH OIL MILL MACHINERY CO.
SCREW PRESS DIVISION
PIQUA, OHIO, U.S.A.

Here's a pump you can use anywhere GOULDS self-priming centripetal pump (Fig. 2520)

pumps liquid... air ... liquid and air

As a scavenger . . . handy transfer . . . for cleaning up—which way can this versatile Goulds pump work for you?

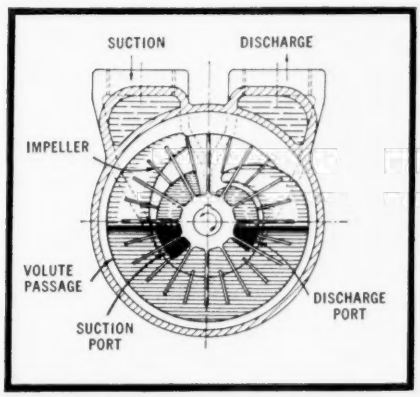
You can use it for almost anything.

Because it pumps air and liquid in any combination, it handles foaming solutions and emulsions easily. It's ideal for pilot plant work, for cleaning operations.

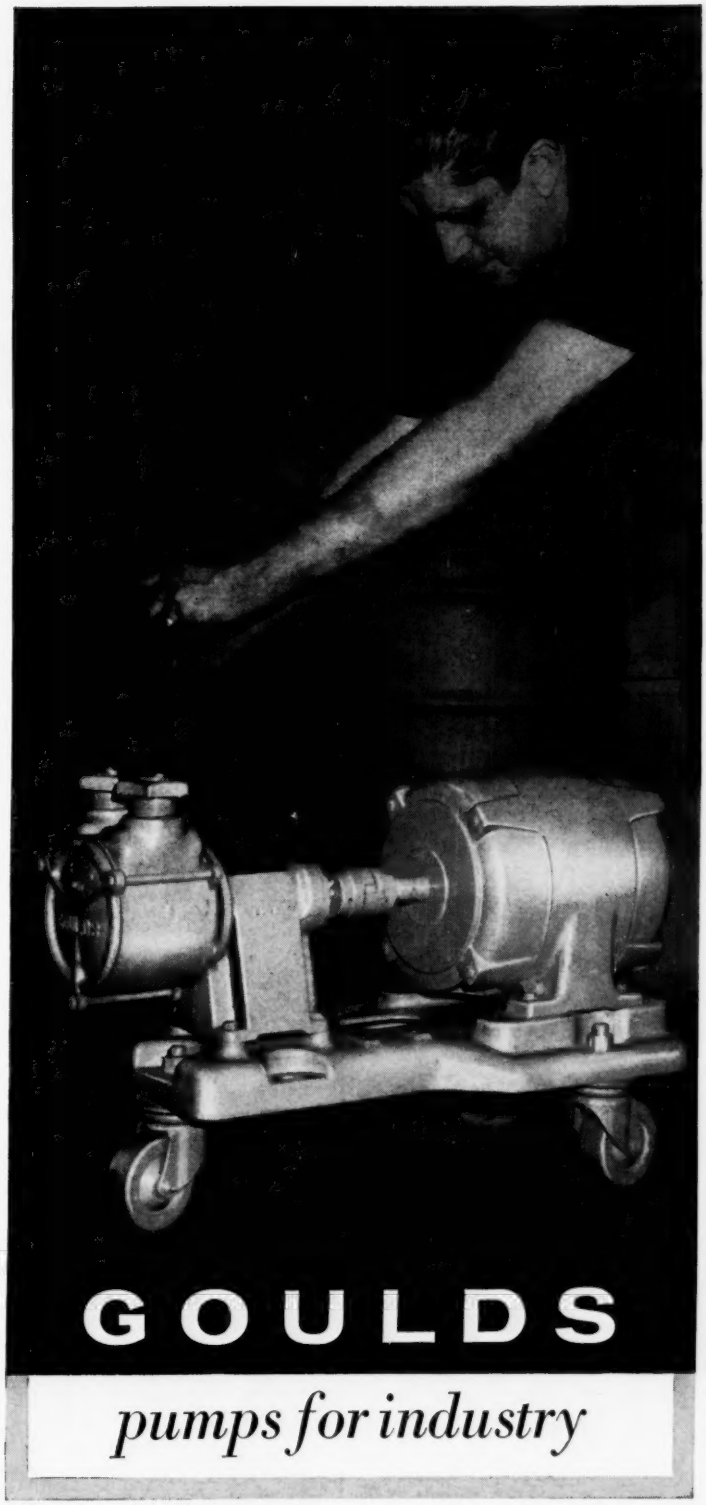
Once primed, it stays primed. It won't air-bind. Even with loops or leaks in your suction line, its high air-handling capacity will keep liquids moving.

Compact, lightweight, portable—it's ready in all-iron construction, or in stainless steel for corrosive service. It's offered as a mobile unit (illustrated), pump-motor unit, or pump only for V-belt drive. The pump itself weighs 42 pounds. With 1½ inch suction and discharge, capacities go to 60 GPM, heads to 80 feet.

There's a complete description of the Liquid Ring Pump in Bulletin 725.6; you can get a copy from us or from your Goulds representative.



This new self-priming Goulds pump eliminates air-binding by a unique use of *centripetal* action. The impeller forces liquids along a volute casing, building up pressure as the liquid moves to the narrow end. This pressure sets up a liquid piston action between each set of blades, forcing liquids to the center of the pump. The liquid piston forces any air entrapped in the center up through the outlet.



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Important—For pages showing more than one advertised item use the guide to numbers on cards above.

44 All items discussed
- 44a Scales
- 44b Scales, counting
- 44c Scales, electronic load cell
- 44d Scales, motor truck
- 44e Scales, remote digital weights

100 All items discussed
- 100a Mixers, turbine
- 100b Mixers, turbine
- 100c Mixers, turbine
- 100d Mixing equipment

191 All items discussed
- 191a Linings & coverings, rubber
- 191b Valves, rubber
- 191c Steel, rubber-lined
- 191d Pail, acid

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Silicone resin 74E, 74F
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Chemicals

Alkyd Compounds.....Plaskon alkyds offer excellent electrical and physical properties in realistic cost range. IBM uses Plaskon Alkyd 446 for precision-molded brush blocks, circuit breakers.
225A Barrett Div.

Antiozonants, Rubber.....Eastozone 30, 31 and 32 protect rubber and rubber products against deteriorating effects of ozone. 4 p. brochure includes chemical and physical properties of compounds.
225B Eastman Chemical Products.

Cloth-Paper Product.....Dura-Weve is made with rayon scrim and high wet-strength paper; resembles cloth in appearance, touch. Used in headrest covers, hand towels, disposable garments. Form No. 2202.
225C Scott Paper Co.

Crystals.....Benefit from the 11 important features combined in Solvay's snowflake crystals, two superior form of sesquicarbonate of soda. Non-caking, free-flowing, quick dissolving. Write for Fact Book.
73 *Allied Chemical & Dye Corp.

Curing Agent.....Emeri-Crete Kure dustproofs and rejuvenates old floors; is both a curing agent and surface hardener on new cement floors. Data sheet gives specifications for application.
225D Walter Maguire Co.

Finishes, Epoxy.....4 p. bulletin describes chemical and physical properties of both maintenance and decorative epoxy finishes. Includes data on selection of epoxy film for steel, concrete bases.
225E Hauger-Beegle Associates.

Flexibilizer, Epoxy.....Cardolite brand epoxy resin flexibilizer NC 513 reduces viscosity of epoxy systems; improves impact, flexural properties without reduction of chemical resistance.
225F Minnesota Mining & Mfg. Co.

Glycol Polyethylene.....Tensiorex P, Belgian polyethylene glycol, prevents caking of ammonium sulfate. Addition of 100 g. per ton of sulfate cuts labor, maintenance of handling equipment by 20%.
225G Belgian Information Service.

Glycols, Polethylene.....54 p. booklet discusses properties, applications, storage, specifications, testing of Carbowax polyethylene gloycols. Includes physiological properties, viscosities of blends.
225H Union Carbide Chemicals Co.

Inhibitor, Acid.....SOLE-ONIC PH-1 is 100% active material which may be formulated with dry or liquid acids. Very effective with most ferrous and non-ferrous alloys. Bulletin 258-1.
225I SOLE Chemical Corp.

Lubricant.....Cut bearing maintenance with one lubricant—Esso's Nebula EP. A multi-purpose grease that works exceptionally well in ball, tapered roller and roller bearings. Write for free brochure.
75 *Esso Standard Oil Co.

Plastics.....8 p. booklet contains application, physical property data on plastics produced by Naugatuck Chemical. Includes 7 types of Kralastic, 7 Vibrin polyester resins, 12 Marvinol vinyl resins.
225J Naugatuck Chemical Div.

Plastics, Antistatic.....PC-52, PC-93 and PC-19 are static-free buffing compounds for cutting and coloring all types of plastics. They have built-in lubes to prevent burning, roll-over. Bulletin PBC-100.
225K Hanson-Van Winkle-Munning Co.

Plastics, Clear.....Illustrated 6 p. brochure covers physical and chemical properties of six special clear plastic materials as well as a coating material for emergency repairs.
225L Homalite Corp.

* From advertisement, this issue

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Polyethylene, High-Density.....Basic manufacturing techniques for using GREX high-density poly are described in "Molder's Guide to Injection Molding GREX" and "Fabricator's Guide to Extruding GREX."
226A W. R. Grace & Co.

Polyethylene, High-Density.....Price of Hi-fax high-density poly has been lowered. Base price, in carload quantities, has been cut from 47¢ to 43¢ per lb. for general purpose series.
226B Hercules Powder Co.

Protective Coatings.....Comprehensive 36 p. manual features actual color chips of 102 coating items and includes sections on methods of surface preparation, use of primers, finish coatings. Catalog 257.
226C Rust-Oleum Corp.

Radioactive Isotopes.....Price List "C" covers radioactive isotopes and isotope-labeled compounds. It adds to previous issues an expanded list of C-14 compounds; sections on heavy water, N-15 compounds.
226D BIO-RAD Laboratories.

Silane Finishes.....**"From Flying Machines to Flyrods," From Rockets to Radios"** describes how silane finishes A1100 and A172 put force into reinforced plastics. Form SF-1094A.
226E Union Carbide Corp.

Silicones.....12 p. brochure outlines properties of silicones as dielectric materials. Also discusses use of silicone rubbers, fluids, resins in electrical, electronic systems. Brochure 10-105.
226F Dow Corning Corp.

Silicone Oil.....L-45 silicone oil, electrical grade, is clear dimethyl silicone polymer used as an insulating and cooling medium in capacitors, small transformers, etc. Data sheet describes properties.
226G Union Carbide Corp.

Solvents.....Booklet "Shell Aromatic Solvents for the Coatings Industry" gives typical properties of these solvents. Variety of evaporation rates is shown, plus all individual characteristics.
59 *Shell Oil Company

Solvent recovery.....Save 65% to 80% on process solvent costs. Recovers practically all volatile solvents and solvent mixtures . . . safely, efficiently and economically. Write for booklet on solvent recovery.
225 *Union Carbide Corp.

Textile Chemicals.....**"Chemicals for the Textile Industry"** summarizes textile applications for organic chemicals. Also contains charts, conversion tables useful in research, production calculations.
226H Union Carbide Chemicals Co.

Wax Properties.....Physical properties of some 37 natural and synthetic waxes are tabulated in a chart which includes melting and congealing points, densities, penetration values.
226I Baker Castor Oil Co.

* From advertisement, this issue

← Want more information on any of these items? Just circle its code number on the postcard (P. 220), then mail to us. It's that easy.

Construction Materials

Alloys.....Newly published booklet describes Hastelloy alloys—unusual resistance to hot mineral acids, strongly oxidizing salts, and powerful gaseous oxidants. Write to distribution Section for booklet.
165 *Haynes Stellite Co.

Aluminum.....Beat corrosion in four ways with Alcoa aluminum building materials—no rust, low cost, strong, and good looking. Free 36-page book, Alcoa Aluminum Industrial Building Products gives info.
116 *Alcoa Aluminum

Corrosion-Proof Materials.....You get permanent plant-wide protection against corrosives with Atlas corrosion-proof cements and tank linings, and with Atlas rigid plastic structures. Bul. CC-3.
218 *Atlas Mineral Prods. Co.

Linings, Laminated.....Kel-F Laminate a thermoplastic resin can make equipment and piping extremely resistant to acids, alkalies and solvents at temperatures to 350° F. Bul. AD-152.
187 *U. S. Gasket Co.

Smokestack, Glass-Lined.....Permaglas smokestack, in which glass is bonded to steel, is built to provide 300-500% longer protection against corrosion. Unit resists attack of conventional fuels. Bull. SS-202A.
227A A. O. Smith Corp.

Steel, rubber-lined.....For high pressures or big pipe lines. Excellent for alkalis, most inorganic acids, many organic acids, all salts, bleaches. Sizes 1¼" to 24" and up. Write for Bulletin CE-52.
191c *American Hard Rubber Co.

Steel, Stainless.....Armco makes complete line of stainless steels. Provide high strength at elevated temperatures and improved resistance to oxidation and corrosion. "Armco's ELC Stainless Steels".
31 *Armco Steel Corp.

Talide Metal.....Talide metal, a superior tungsten carbide, is harder, stronger and more resistant to abrasion than any other metal. It is used to wear-proof vital parts. Catalog 56-G.
102 *Metal Carbides Corp.

Teflon, Glass-Supported.....Bulletin GST-58 gives mechanical, electrical, chemical properties of C-D-F glass-supported Teflon in sheets, tapes, laminates, metal-clads, etc.
227B
Continental-Diamond Fibre Corp.

Electrical & Mechanical

Clutch, Electro-Magnetic.....Heavy-duty 4200 series of electro-magnetic disk clutches features detachable drive and driven hubs. Light, compact units used on ball, rod mills; kilns. Bulletin 501.
227C Stearns Electric Corp.

* From advertisement, this issue

LITERATURE . . .

Conductors.....Available for temperatures from 320 F. to 3,000 F. Conductors are supplied from 36 to 12 gage. Standard lengths are up to 30 ft. Special, up to 60 ft. Write for Catalog 31-300-E.
208 *Thermo-Electric Co., Inc.

Flow Alarms.....Magnetic and electronic types of fluid flow rate alarms—forsignalling or simple control functions—are available for use with rotameters to meet any flow requirement. Bulletin 165.
228A Brooks Rotameter Co.

Motors.....Only U. S. Motors insulates all windings with asbestos. Your best protection against motor burnout and production shutdowns. Free color-illustrated brochure shows advantages of U. S. motors.
123 *U. S. Electrical Motors

Motors.....New pancake motor preserves all the advantages of conventional motor construction. Your solution to trouble-free power in any space-cramped motor application. Write for Bulletins 2100 and 2150.
110 *Louis Allis Co.

Motor Control.....Front access, high voltage starters (Type H) for 2,300 to 5,000-v. motors provide maximum accessibility, protection, performance and space economy. Bulletin 14B8507.
228B Allis-Chalmers.

Seals.....Chempac Teflon clipper seals enable industrial plants to obtain positive sealing in presence of and in contact with active solvents and corrosives. Effective against diverse fluids.
228C Johns-Manville Corp.

Seals, Mechanical.....Chempro is only external mechanical seal with seal faces located inside the pump stuffing box. Never completely immersed in the pumping liquid. Write for Bulletin CP551.
204 *Chemical & Power Products, Inc.

Speed Reducers.....Unicentric drives, for driving all kinds of heavy rotating machinery at low and medium speeds, come in both parallel shaft and right angle type units for sever service applications.
228D H. W. North Co.

Switches, Pressure.....Tier-tube line of pressure switches for highly corrosive media such as fuming nitric acid, fluorine, etc. Proof pressures range from 224 to 6000 psi. Buls. 1110-1170.
186 *Barksdale Valves.

Tower Packings & Support Plates..... Now saddle packings and tower support plates are available in carbon. Bulletins S-29, TP-54 and TA-30 on tower packings, support plates, distributors.
50 *U. S. Stoneware Co.

Turbines.....Design benefits include easy inspection, simple replacement and interchangeable components. Elliott field engineers are always nearby to help with your problems. Write for Bul. H-22B.
107 *Elliott Company

Turbines.....Exclusive pilot operated excess speed safety trip supplementing constant speed governor; choice of metallic or carbon ring packing assemblies. For full details write for Bulletin 135.
39 *Coppus Engineering Corp.

* From advertisement, this issue

V-Belt.....Condor LS V-belt, made for long center, heavy duty drives, features precision proportioned construction said to eliminate V-belt whip and turn-over that leads to belt failure. Bulletin M210.
229A Manhattan Rubber Div.

Drives Variable-Speed.....High accuracy infinitely variable speed drives produce increased torques at either maximum or minimum speed, whichever the application requires. Bulletin 550.
229B Graham Transmission Inc.

Handling & Packaging

Conveyor Components.....Recently introduced screw conveyor components reduce power demands and maintenance delays. They include conveyor screws, hangers, trough end seals, etc. Folder 2489.
172 *Link-Belt Co.

Scales.....Today weighing is a vital element in your overall cost control system. New Toledo Weight Fact Kit will help you determine how well your scales measure up as a weighing system.
44a *Toledo Scale Div.

Tanks.....Suppliers to the chemical processing industry for three generations. Elevated tanks, pressure vessels, chemical and processing equipment from aluminum, model and other alloys. Write for "Tank Talks."
TR233 *R. D. Cole Mfg. Co.

Trucks Lift....."What Makes Towmotor Tick" is behind-the-scenes account of engineering principles involved in production of fork lift trucks, plus analysis of components going into finished product.
229C Towmotor Corp.

Weighing Systems.....Amazingly simple Emery tank weighing systems, based on the sturdy Emery hydraulic load cell, speed the control of contents in multi-tank operations. Buls. 561 & 571.
67 *A. H. Emery Co.

Heating & Cooling

Air conditioning.....Dry and clean air at the right temperature. Compact method gives high capacity in small space, removes moisture from air by contact with a liquid small spray chamber. Buls. 112 and 131.
BR237 *Niagara Blower Company

Condenser, vapor.....Reduce operating cost of vacuum systems with "Aero" vapor condenser. May be installed directly above stripping column or vaccum evaporator. Write for Bulletin 129R for more information.
TR229 *Niagara Blower Company

Ejectors, Steam Jet.....Company offers descriptive bulletins on single-stage, multistage and corrosion-resisting types of steam jet ejectors. Versatile design and construction for CPI uses.
198 *Elliott Co.

* From advertisement, this issue

LITERATURE . . .

Evaporators.....Food, chemical, pharmaceutical . . . whatever your processing need, there's a custom-designed Swenson evaporator to help improve your product quality. Booklet, "An Open Door."
83 *Swenson Evaporator Co.

Heat Exchangers.....Details of expanded line, performance improvements and new design features of 1958 Type BCF exchangers are contained in Bulletin 1.1K6. Specs of 46 sizes in 1, 2, 3, 4-pass designs.
230A Ross Heat Exchanger Div.

Heat Exchangers.....New baffles with flanged lip at each tube hole; improved thermal characteristics. New stamped steel feet, movable in three positions. 46 models. Write for Bulletin 1.1K6.
99 *American-Standard

Heat Transfer Equipment.....Vogt shell and tube reactors for poly plants, and wide range of heat transfer equipment for chemical plants, petroleum refineries and related industries. Bul.
157 *Henry Vogt Machine Co.

Heaters, Dielectric.....Cut costs, save space, speed production with dielectric heaters. Available in a complete range from 3 kw to 100 kw. See your nearby representative or write for Bulletin 15B6431C.
127 *Allis-Chalmers.

Heaters, steam.....Heat and agitate liquids in tanks, efficiently, economically, and with less noise with SK steam jet heaters. Long, trouble-free service without costly supervision. Write for Bulletin 3A.
101 *Schutte & Koerting Co.

Heaters-Coolers.....Bulletin 135 on air engineering for process industries describes after-coolers, air conditioners, liquid coolers, heat exchangers, condensers, refrigeration equipment.
230B Niagara Blower Co.

Kilns, Rotary.....Traylor engineers have built hundreds of rotary kilns which are now in use throughout the world. They'll help solve thermo-processing machinery problems. Bul. 1115.
32 *Traylor Engrg. & Mfg. Co.

Refrigeration Equipment.....Graham steam vacuum refrigeration offers you the best solution to your process water requirements if you will need colder water this summer. Bulletin 60-A.
182 *Graham Mfg. Co.

Traps, Steam.....Company offers name of the industrial distributor nearest you, as well as free steam trap bulletin and Piping Diagram and Trap Selector for chemical processing equipment.
97 *Yarnall-Waring Co.

Instruments & Controls

Analyzer, Gas Chromatography.....Chromax analyzer can analyze as many as four process streams containing natural gases, vapors, hydrocarbons, with eight such components in each stream. Folder ND46-91(7).
230C Leeds & Northrup Co.

* From advertisement, this issue

Controls, Photoelectric.....24 p. catalog describes normal, high speed, ultra sensitive, impulse-actuated, plug-in mounted photoelectric controls. Also covers complete series of light sources.
231A Autotron

Controls, Temperature.....Improved design remote bulb temperature controls. A complete line of temperature, pressure, vacuum controls. For additional data request section 200 of new catalog.
194 *United Electric Controls

Gages, liquid-level.....Complete line of liquid level gages and valves. Penberthy's "floating shank" lines up off-center holes and assures accurate mounting. Catalog 36 gives all pertinent information.
201 *Penberthy Mfg. Company

Hygrothermograph.....Model HGS-HYT-1 hygrothermograph is an instrument in which sensitivity, range and lag of humidity and temperature sensing units are of the same order of magnitude.
231B Serdex.

pH Equipment.....Bulletin 5400 gives detailed descriptions, specifications for all Beckman industrial pH instruments, electrodes and accessories. Profusely illustrated with photographs, drawings.
231C
Beckman/Process Instruments Div.

Spectrophotometer.....Vol. 3, No. 2 of "Infrared Notes" features low cost, double beam IR-5 spectrophotometer for routinely running infrared analyses. Also includes uses, applications of Beckman IR-4.
231D Beckman.

Telemeters.....8 p. bulletin describes how Chronoflo telemeters enable users to observe and record operation of widely scattered meters at a central location from any distance. Bulletin 230-P4.
231E Builders-Providence.

Pipe, Fittings, Valves

Coils, thermo-panel.....Replaces old-style pipe coils. Cost less, requires less space. Lighter, more efficient. Ask for Bulletin 355 and tell us your heat transmission problems.
TR245 *Dean Thermo-Panel Coil

Couplings, Flexible.....Sure-Flex coupling consists of two flanges and two-piece rubber sleeve which lock together without clamps. Product can withstand all combinations of misalignment. Bulletin 10100.
231F T. B. Wood's Son's Co.

Elbows, reducing.....Midwest reducing elbows offer several advantages —reduce turblance and pressure drop because of gradual taper; fit into smaller space; improve appearance of piping. Write for Catalog 54.
177 *Midwest Piping Co., Inc.

Joints, Expansion.....Flexon, answer to pipe expansion problems. Free-flexing and controlled-flexing; pressure balanced joints. All in stainless steel, monel and other workable alloys. Write for Flexon Design Guide.
200 *Flexonics Corporation

* From advertisement, this issue

LITERATURE . . .

Joints, swivel.....Assure yourself of minimum maintenance with long trouble free operation by specifying Chiksan swivel joints. These joints handle air, hydraulics, fuels, oils. Write for Catalog G-4.
113 *Chiksan Company.

Nozzles.....Be sure of a perfect conical shape spray all the time with Monarch. Applicable to acid chambers, air washing, chemical, processing, cooling ponds, gas scrubing. Send for Catalog 1.
232 *Monarch Mfg. Works, Inc.

Pipe.....Easy to install, Koroseal PVC can be cut, threaded, welded or drilled. Excellent insulation properties, will not support combustion, and never needs painting. Ask for booklets on pipe and sheet.
246 *B. F. Goodrich Co.

Pipe, PVC.....Tough, rigid, acid-resistant National polyvinyl chloride pipe comes in two types, normal impact and high impact. Available in sizes up to 14" O.D. Request Bulletin 24.
38 *U. S. Steel Corp.

Pipe, Saran lined.....Economy with the immediate availability of pipe, fittings and valves as stock items. Superior corrosion resistance and strength. Literature available on pumps and sheeting also.
115 *Dow Chemical Company

Tubes Venturi.....Comprehensive bulletin describes types of Venturi tubes, their recovery characteristics, formulas determining their design, typical calculations. Bulletin 110-P1.
232A Builders-Providence.

Tubing.....Company is ready to handule special tubing problems, where an unusual tubing length is required or where severe corrosive conditions are present. Simplified procurement. Bul. TB-417.
132 *Babcock & Wilcox Co.

Tubing, Armored.....A polyvinyl chloride sheath over spirally cabled copper or aluminum instrument tubing provides complete moisture and corrosion protection for tubes. Bulletin 356-H.
TL230 *Crescent Insulated Wire.

Tubing, flexible.....Expands, contracts, absorbs vibration. Withstands abrasion, exposure. Available in bronze, galvanized or stainless steel. Ask for "Flexineering," illustrating science of engineering tubing to job.
236 *Penn. Flexible Metallic Tubing.

Unions, steel.....NEW . . . for the first time, a guide to help you select better unions. This 16-page handbook gives the facts about the use of unions in your plant. Write for a free copy of this booklet.
195 *Clayton Mark & Co.

Valves, Diaphragm Motor.....A Fisher diaphragm motor valve is the preferred control in the power and process industries. Extra-thick steel casing, precision finished valve stem. Bul. E657A.
37 *Fisher Governor Co.

Valves, gate.....Exceptional performance. Longer valve life, less maintenance, easier operation. Made in various alloys, types and sizes for most services. Send for complete information in Catalog 57.
223 *Darling Valve & Mfg. Co.

* From advertisement, this issue

Valve, glassed.....No cracking, no crackling with this new all-glassed valve. Costs no more than a conventional stainless steel valve. Comes in six sizes. More information available in Data Sheet 42.
248 *The Pfaudler Company.

Valves, Packless.....Best guarantee of positive leakproofing under most any conditions. Available in many sizes and types. Extensively used in chemical and nuclear energy service. Request catalog F.
193 *Robertshaw-Fulton Controls

Valves, plug.....Efficient, economical chemical service with W-K-M plug valves. Permits full flow, has quick on/off control, and is corrosion resistant. ACF lubricated plug valves are described in Catalog 400.
71 *W-K-M, ACF Division

Valves, rubber.....Stop valve corrosion at lower cost. There's an Ace hard rubber, rubber-lined, or plastic-lined for every corrosion application. Sizes from 2" to 24". Bul. CE-52 lists use in chemical field.
191b *American Hard Rubber Co.

Process Equipment

Dissolvers.....High quality metallic dispersions can easily be controlled and produced in big volume, using new dissolver. Technical Bulletin 21-1957, "Metallic Dispersions with Cowles Dissolver."
41 *Morehouse-Cowles Inc.

Dryer.....Pritchard Hydryer has exclusive features—no waste, full line pressure reactivation, longer absorbent life, no moving parts, reactivation gas pre-heated. Write for Bulletin on Hydryers.
224 *J. F. Pritchard & Co. of Cal.

Dryers.....Stokes Model 238 series of vacuum shelf dryers for heat-sensitive, air-sensitive or pyrophoric materials carries ASME Code Certification on all pressure parts. Bulletin 630.
233A F. J. Stokes Corp.

Dryer, Vacuum.....Faster, better way to vacuum-dry heat sensitive materials. Inquire about P-K's Customer Service Laboratory to pretest your specific requirements. Write for Data Sheet 1530.
52 *Patterson-Kelley Co., Inc.

Dust Collectors.....Type N Roto-Clone hydrostatic precipitator collects heavy dust loadings of all particle sizes. Highly efficient, with simple, compact design. Bulletin 277 has full data.
98 *American Air Filter Co.

Dust Collectors.....Ducon centrifugal wash collector, Type UW-4, is a basic air scrubber with applications for the wet principle collection of problem dusts & recovery fines. Bul. W-7456.
185 *Ducon Co.

Filter Cloth.....Wedge-shaped openings allow only the filtrate to pass through. Reversible, both sides identical. Available in variety of weaves, in all malleable metals. Send for new catalog E.
196 *Newark Wire Cloth Co.

* From advertisement, this issue

LITERATURE . . .

Filter Presses.....Company's filter presses are available in designs and capacities to handle any filterable mixture and any filter material. Up-to-date, illustrated filtration catalog.
199 *D. R. Sperry & Co.

Filters, Corrosive Liquid.....Line of filters will solve problems of danger to personnel, of high temperature control, and of giving corrosive liquids a high polish. Bulletin 431.
47 *R. P. Adams Co.

Filters Dust.....“Roll-Clean” Dynaclone self-cleaning, continuously operating dust filter is described in 36-page Bul. 104. Complete dust seal, easy filter bag changing, free-rolling cleaner.
L228 *W. W. Sly Mfg. Co.

Filters, vertical.....Why not look into the advantages of modern filtration for your process needs. Industrial vertical filters can help you organize a filtration system that fits your process. Ask for Bul. 111.
30 *Industrial Filter & Pump Co.

Flakers.....Bulletin 370 describes continuous process for cooling, flaking chemicals. Includes descriptions and specs. of Buflovak flakers, new features for flaking new products, roto-shelf coolers.
234A Buflovak Equipment Div.

Mills, Roller.....Raymond super roller mills satisfy the maximum demands of industry for huge tonnages of high fineness materials. Available in several sizes. Write for Catalog No. 79.
134 *Combustion Engineering, Inc.

Mixers.....Strong-Scott turbilizer provides fast, thorough dispersion, disintegration and blending of dry materials, or pastes involving liquids and solids. Write for free color bulletin.
81 *Strong-Scott Mfg. Co.

Ovens.....Line of ovens is designed for truck or rack loading; models available in either gas or electrically heated units. Ideal for baking phenolic finishes on coils; drying latex, ink, chemicals.
234B Despatch Oven Co.

Process Equipment, Impervious Graphite.....Company's impervious graphite equipment includes rupture disks, chemical pumps, heat exchangers, etc. Bulletin 249 has drawings, cost figures.
205 *Falls Industries Inc.

Screens.....Construction details including super-active ball cleaning device, are described in bulletin on complete line of Ro-Ball sifters and gyrating screens. Bulletin 957.
234C J. H. Day Co.

Separators, Magnetic.....Rotating field magnet separators were designed for attachment on top of Carpco's standard high intensity induced roll mineral separators. Bulletin RFB-101.
234D Carpco Mfg.

Wire Cloth.....Free 94-page catalog and stock list tells full range of wire cloth available, describes fabrication facilities and gives useful metallurgical data. Orders filled promptly.
R234 *Cambridge Wire Cloth Co.

* From advertisement, this issue

LITERATURE . . .

Pumps, Blowers, Compressors

Compressors.....Rugged, round-the-clock service with R-C compressors. Engineered with R-C patented Rotor Design, they insure greater efficiency, dependability, and economy. Bulletin LAL-458.
103 *Roots-Connersville Blower

Compressors.....For oil-free air, use Joy's oil-free compressors. These compressors use carbon piston rings that require no lubrication. No oil in cylinder—no oil in compressed air. Write for Bulletin 167-11.
7 Joy Manufacturing Co.

Compressors, Centrifugal.....Rugged De Laval centrifugal compressors perform dependably in heavy-duty continuous operation in many refinery services. New Bulletin 0504 is available on request.
40 *De Laval Steam Turbine Co.

Compressors, Centrifugal.....Two basic types—horizontally split case for low to moderately high pressure ranges; vertically split case for extremely high pressure conditions. Write for Bulletin 150.
20-1 *Clark Bros. Co.

Fans.....Resin-bonded fiber glass fume fans are corrosion-resistant, impact-resistant and won't support combustion. All details, including chemical resistance tables, in Bul. FI-511.
112 *Buffalo Forge Co.

Fans, Ventilating.....Bulletin UVS-104 covers General Blower's complete line of belt-driven ventilating units with either forward curve wheels or backward blade non-overloading wheels.
235A General Blower Co.

Pumps.....Avoid messes, save time, and cut costs—all by using Viking pumps. "Gear-within-a-gear" is secret of successful performance. Available for most industrial needs. Ask for folder 58SC.
B245 *Viking Pump Company

Pumps.....Bulletin V-837 describes vertical pumps, with design permitting the location of the stuffing box above and out of liquid level. Bulletin C-355 describes horizontal pumps. Both free.
183 *Taber Pump Co.

Pumps.....Pump Selector Bulletin 158 briefly describes types of Nagle pumps, all of which are for abusive application, such as those involving corrosion, abrasion, high temperature.
235B Nagle Pumps

Pumps.....Each SSV centrifugal pump is custom-made to fit your particular operation, whatever the consistency or type of liquid you move. Open and enclosed impeller types. Bul. 107.
R236 *Frederick Iron & Steel Inc.

Pumps, Centrifugal.....SVA line of 21 single-stage pumps is divided into four groups having 20 major parts interchangeable within each group. Rotating element forms completely unitized assembly. Bulletin 136.
235C Pacific Pumps

* From advertisement, this issue

LITERATURE . . .

Pumps, centripetal.....Can be used anywhere. Pumps liquid . . . air . . . liquid and air. Once primed, it stays primed. Compact, lightweight, and portable. Weighs only 42 pounds. Write for complete description Bul. 725.6
217 *Goulds Pumps, Inc.

Pump, Diaphragm.....Model 47 Heavy Duty Chem-O-Feeder is all-purpose, positive displacement pump designed for safe, dependable feeding of a wide variety of corrosive fluids. Bulletin 1225-2.
236A Proportioneers.

Pumps, Vacuum..... Combination "Two-Stage" pump gives outstanding service at low micron range—faster pump-down, higher efficiency compared with single-stage pumps. For both dry and wet systems.
236B Beach-Russ Co.

Services, Processes, Misc.

Clothing, All-Weather.....Line of polyvinyl chloride-impregnated North PVC garments features head-to-toe, foul-weather protection for personnel engaged in outside occupations.
236C Jomac Inc.

Clothing, Dacron.....Newly developed industrial apparel of 100% Dacron not only resists acids and corrosives, but also is unusually resistant to concentrated hydrogen peroxide.
236D Worklon.

Equipment Fabrication.....Illustrated bulletin details facilities, services and qualifications of Niagara Welding & Boiler Works for chemical, process, food, beverage, power, metal refining industries.
236E
Niagara Welding & Boiler Works.

Fire extinguishing system.....Have 24-hour a-day automatic fire protection with Kidde's fully automatic system. Pressurized, no falling weights, no clumsy mechanical triggering methods. Write for Booklet I-19.
180 *Walter Kidde & Co., Inc.

Nuclear Engineering.....24 p. illustrated booklet describes personnel and basic services of Nuclear Science and Engineering Corp.; radioactivity problems of nuclear power industry; nuclear techniques.
236F Nuclear Science & Engineering

Safety Equipment.....12 p. folder illustrates some 26 different technical enclosures for safe handling of all types of contaminants. Of interest to those in atomic, radiochemical fields.
236G S. Blickman.

Scale Models.....44 p. catalog of model components presents those items which are most common to field of engineering modelmaking. Includes fittings for full scale, center-line piping.
236H Engineering Model Associates.

TV, Industrial.....Versatile, simple, and low cost are advantages of industrial TV by GPL. Write for free, illustrated brochure on General Precision Laboratory equipment—the most complete line.
R232 *General Precision Laboratory

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CLASSIFIED . . .

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CE's Searchlight spots the big bargains in used, resale and rental equipment. Check this issue's listings—most complete in the field—for items you need now.

▶ **Coverage**—National (see index of advertisers in this section for your nearest dealer). Equipment and facilities—used, resale and rental—for the process industries. For sale, wanted, for rent.
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LOEB OFFERINGS

Autoclave: 50 gal. Struthers-Wells, st. st.
Centrifugals: 12", 17", 20" and 26".
Clarifiers: De Laval and Sharples.
Crystallizers: 500 gal. stain. steel, jacketed.
Dryer: Devine 2 x 4' vac. drum, st. steel.
Fillers: for liquid, paste, powder.
Filters: Eimco, Oliver, Sweetland, Alsop, Sparkler, Industrial, Sweetland.
Filter Presses: Sperry, Shriver 6" to 36".
Kettles: Stainless steel, with and without agitators.
Dopp 150 gal. dbl. act. agitator.
Mills: Mikro Bantam, 2TH and 24". Jeffery 30 x 24" type A.
Mixers: Dbl. and Sgl. arm sigma blade. Dry Powder, various sizes. Gemco stainless steel, 7½ hp.
Mix-Muller: Simpson st. st. bowl 39".
Percolator: Pfaudler 54 x 42" st. st., jack.
Pumps: Rotary, gear, centrif., vacuum.
Screen: Tyler model 300, 5 hp.
Tanks: Stainless steel, various sizes.
Vacuum Pan: 42" Harris st. steel.

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Complete with all agit. acc., 5 HP XP motor. XP light. G/L ext M/H collar, flush valve. Teflon gaskets & code.
Unit is in perfect cond.—no flaws whatsoever.
FS-7526, Chemical Engineering
Class. Adv. Div., P.O. Box 12, N.Y. 36, N. Y.

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35000#/hr @ 285#
60000#/hr @ 435#
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750 gal. jktd. Steel Reactor 300#
50 gal. jktd. Stainless Reactor 50#
6'x29' Bubble Cap Column S.S. 347
9'x42'6" Column 410 S.S. lined 150#
6'x37'2" Column 410 S.S. lined 150#
705-24 Roto-Louvre Dryers
502-16 Roto-Louvre Dryers
6'x50' Louisville Steam Tube Dryers
6'x10' Rotary Vac Drum Dryer
4'x30' Ruggles Cole XH2 Dryer
5'x30' Buflovak Rotary Vac. Dryer
8'6"x50' Allis Chalmers Kiln
12,000 gallon Aluminum Tank 75 PSI.
14"x30" Day 3-roll High Speed Mill
Pebble Mills 5'x6', 4'x5', 3'6"x4'.
30" Fletcher St. Steel Susp. Cent.
40" Fletcher St. Steel Susp. Cent.
24"x20' Swenson Crystallizers (3)
Sweetland Filter #10 27 leaves
24" Filter Press 36 NEW Wood P.F.
Stokes DD2 Tablet Presses (2)
3'x6' double deck St. Steel Screen
50"x14'6" Pug Mill W. 60 HP Motor
4,000# Jacketed Ribbon Blender
2,000# Ribbon Blender

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2—Sharples C-27 Super Dehyd. 316 S.S. 50HP
1—A T & M 42" susp perf basket Centrifuge
10—Pfaudler 1000 gal Model R Reactors
1—Pfaudler 1500 gal jcktd agit glass lined Tank
1—Oliver 3' x 2' Rotary cont. Vac. Filter
1—Eimco 8' x 8' Rot. Cont. Vac. Filter. Comp.
1—Oliver 8' x 10' Precoat Vac. Filter. Comp.
1—Buffalo double drum Dryer, 42" x 90" mtr
1—Louisville 4' x 15' Rotary Kiln. Complete
2—9' dia Rotary Dryers, 20' and 56' long
2—Link-Belt Roto-Louvre Dryers 207-10, 310-16
2—6' x 45' Louisville Flame Dryers
2—6' x 50' Louisville Rotary Steam Dryers
1—Williams 4 Roll High Side Mill, Spinner
1—Raymond 3 Roller High Side Cone Separator
1—Gayco 10' Separator with 30 HP motor
5—Karbate #240A Heat Exchangers, shl & tube
1—Sturtevant #24 Blender, 900 cu ft cap 50 HP
1—Readco 25 gal double sigma jcktd Mixer
2—Ribbon Blenders 1 ton cap motor drive
1—Fitzpatrick Model D Comminuting machine
1—Fitzpatrick Model K Comminuting machine
3—Tyler 3 x 5' Hummer-Screens, stainless
3—Stokes BB-2 Rotary Tablet Presses
1—Penna Crusher, size SXR-1, used for lime
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1—Briquet Press, 315 TPH capacity, complete
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Tolhurst 40" Cent., Plough and bottom dump
Nash Hytor Vac. Pump #6, with 40 H.P. motor
Gen. American 42"x120" Twin Drum Dryer

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2' Symons Shorthead Cone Crusher
30" x 36" Traylor H. Jaw Crusher
56"x72" & 48"x60" Traylor Jaw Crushers
30 x 30 & 24 x 24 L.B. Coal Crushers
24" x 18" Jeffrey Hammermill
8' x 60" Hardinge New Ball Mill
4' x 20', 5' x 24' & 6' x 72' Rotary Dryers
4' x 20', 6' x 72', 8' x 150', 7'6' & 11 x 200' also 8' x 125' Rotary Kilns
4' x 20' New Rotary Kiln
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1—42"x120" American

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1—9"x30" and 1-10"x42", Allis-Chalmers Style N, each two pair high. Each has extra set of rolls.

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1—500 gal. 304 S.S. jacketed agitated Reactor with condenser.
1—300 gal. Pfaudler glass lined agitated Reactor.
6—300 to 450 gal. 304 S.S. agitated Kettles.
2—200 gal. 304 S.S. Vacuum Stills with condensers.
3—125 gal. 304 S.S. Kettles.
3—20 and 30 gal. 304 S.S. Vacuum Stills with condensers.

TANKS

2—2000 gal. 304 S.S. Tanks 7' x 7' high, agitated, with S.S. coils.
3—Steel Tanks, 1000 & 2000 gal. cap., 7' x 7' and 64" x 68".
5—125 gal. 304 S.S. Tanks 40" x 24" high.
7—125 to 150 gal. Pfaudler glass lined jacketed Crystallizing Tanks 40" x 24" and 40" x 30".
10—75 to 150 gal. Pfaudler glass lined Crystallizing Tanks.
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1—Condenser Service & Engineering 304 S.S. Evaporator, 750 gal. Single Effect Body with Vapor Dome and Vertical Condenser, condensate pump.

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2—Oliver United No. 50 304 S.S. Pressure Filters.
10—Independent & Shriver Filter Presses 36" to 18".
12—U. S. Stone Ware & General Ceramic Vacuum Filters, 25 gal. top, 50 gal. bottom.

CENTRIFUGALS

1—Hercules 40" rubber covered perforated, center slung Centrifugal, Type UT, 900 rpm, rubber lined curb, V-belted to L.A. 7½ HP x XP motor 3/60/220/440 volt.

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5—Iron Centrifugal Pumps 1" x 1" to 2" x 2" with XP motors.
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1—Westinghouse Air Compressor, Type 3-YC, 2 stage, 20 cfm at 125# pressure with 5 HP motor and receiving Tank.

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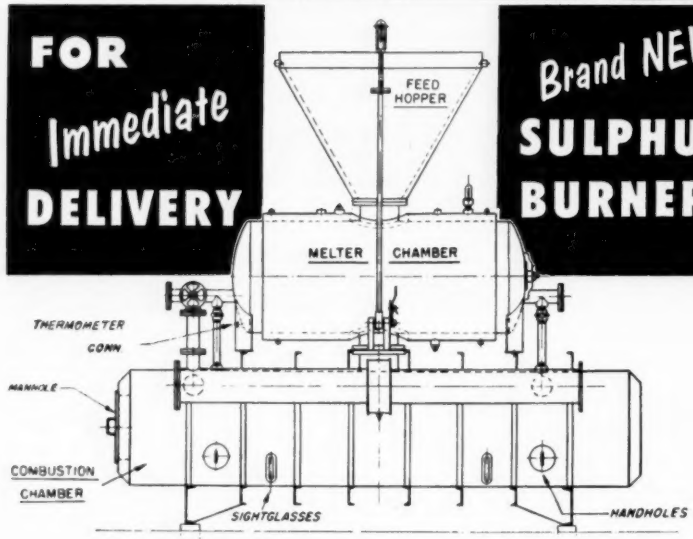

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1	25	75
2	60	150
4	120	300
6	180	450
10	300	750

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2—Hayssen Model 7—17 Box Wrappers.
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J. H. Day late model 3 Roll high speed Mill with chilled steel rolls 5" diam. x 12" long.
4—J. H. Day size G, 1500 lb. Ribbon-type Powder Mixers, split spiral type Agitator.
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4—Stokes & Smith Model G1, G2, G4, HG84, HG87 and HG88 Auger Powder Fillers.

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1—Link Belt Steel Roto Louvre Dryer, Model 604-20, Complete
1—Oliver Horizontal Filter, 6' 6"
1—Niagara Stainless Steel Filter, Model 510-28
5—Pfaudler Series R Jacketed Kettles, 1000 gal.

CENTRIFUGES:

1—Tolhurst Stainless Steel 32" Suspended Type Centrifuge, with perforate basket, complete with motor and plow
1—AT&M 42" Suspended Type Centrifuge, complete with type 347 Stainless Steel Perforate Basket, plow and curb, with 40/20 HP Motor
1—Tolhurst 32" Suspended Type Centrifuge with Imperforate Basket

DRYERS:

1—Traylor Rotary Dryer, 4' x 30'
1—Buflovak Vacuum Double Drum Dryer, 6" x 8"
1—Buflovak Double Drum Dryer, 42" x 120"
1—Stokes Model 59 DS, Steel Rotary Vacuum Dryer, 5' x 30'
2—Louisville Rotary Steam Tube Dryers, 6' x 50', Complete
1—Bartlett & Snow Rotary Dryer, 4'6" x 36'6"
6—Stokes Vacuum Shelf Dryers, 2, 4, 6 and 18 shelves
1—Stokes Double Drum Dryer, 5' x 12'
1—Louisville Rotary Steam Tube Dryer, 8' x 45'

FILTERS:

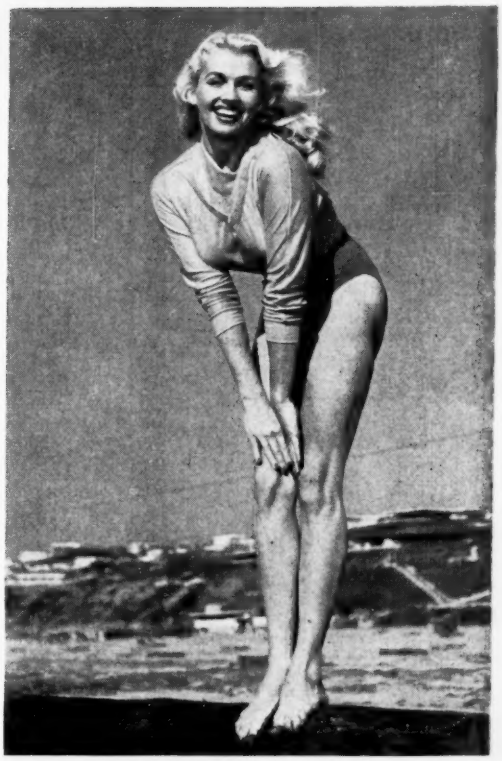
1—Sperry C. I. Filter Press, 24" x 24", 30 chambers (NEW)
1—Sweetland #3 Stainless Steel Filter, 70 sq. ft. filtering area
1—Oliver Horizontal 3' Pilot Plant Filter, New
1—Sweetland #7 Filter with 20 steel leaves (20)
10—Sweetland #12 Filters with 72 Stainless Steel leaves

AUTOCLAVES, KETTLES & TANKS:

5—Stainless Steel Jacketed Kettles, 250, 350 and 500 gallon cap.
1—Combustion Engineers Steel Jacketed Autoclave, 1600 gallons, with agitator and drive, 150# jacket, 600# int.
1—Hamler Steel Horizontal Pressure Tank, 1750 gals., 350 PSI
20—Pfaudler 1000 gallon Vacuum Receivers
1—Glascote Glass-lined Jacketed Kettle, 500 gal.
1—Nickel 1000 gallon jacketed Kettle
1—Lee Jacketed Stainless Steel Kettle, 125 gal.

MIXERS:

1—Entoleter Stainless Steel Continuous Mixer, Type PF
1—Abbe Lennart Jacketed Mixer, 125 gallons
1—Baker Perkins Stainless Steel Double Arm Jacketed Mixer, with compression cover, 2¼ gallons
1—Baker Perkins Stainless Steel Double Arm Jacketed Sigma Blade Mixer, 9 gallons
1—Patterson Steel Jacketed Double Arm Vacuum Mixer, 100 gallons



THE GELB GIRL—APRIL 1958

1—Leader Stainless Steel Jacketed Horizontal Ribbon Blender, 40 cu. ft.
1—Patterson Stainless Steel Jacketed Double Arm Sigma Blade Mixer, 50 gal.
1—Patterson Monel Conical Blender, 4.7 cu. ft.
2—Baker Perkins Double Arm Sigma Blade Jacketed Mixers, 100 gals.
1—Gedge Gray Stainless Steel Ribbon Blender, 65 cu. ft.
1—Banbury Midget Pilot Plant Mixer
3—Robinson Type 316 Stainless Steel Sigma Type Jacketed Heavy Duty Mixers, 400 gallon capacity, 60 HP
1—Process Engineers Stainless Steel Jacketed Ribbon Blender, 30 cu. ft.

MISCELLANEOUS:

2—Williams Hammer Mills Type 316 Stainless Steel, Model AK
1—6" x 12", 3 roll Laboratory Calender
4—Type 317 Stainless Steel Heat Exchangers, 892 sq. ft. ea., 200 PSI
6—Karbate 60 sq. ft. Heat Exchangers
2—Combustion Engineers Water Tube Package Boilers, 200 HP, 275 pressure
30—Struthers Wells Stainless Steel Heat Exchangers, 650 sq. ft. each

1—Stokes Stainless Steel Rotary Vacuum Dryer, 3' x 15'
1—Stainless Steel Jacketed Kettle, 3000 gallons
1—Feinc Stainless Steel Rotary String Filter, 3' x 3' (NEW)
1—Selectro Stainless Steel Vibrating Screen, 3 deck, 3' x 4'

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How Koroseal helps cut cost of nickel-plating jewelry

THE Victory Polishing and Plating Company of Providence, Rhode Island specializes in the nickel-plating of jewelry, turning out such items as nickel-plated cuff links, tie bars, necklace chains and pins. The nickel solution used is highly corrosive and runs at an almost constant 130°F. Ordinary "acid-resistant" hoses continued to fail—they couldn't take the combined assault of corrosion and heat.

Then, in the summer of 1956, the company installed B.F.Goodrich Koroseal rigid polyvinyl chloride pipe. Result: absolutely no maintenance is required, and close examination shows no apparent wear. This company is replacing all of its "acid-resistant" hose with Koroseal pipe, and has lined all its acid storage tanks with rigid Koroseal PVC plate.

Versatile Koroseal has answered countless problems for alert manufacturers. Koroseal is unaffected by most alkalies and acids, and is completely inert in the presence of oil, alcohol, and salt solutions.

Exceptionally easy to install, Koroseal PVC can be threaded, cut, welded or drilled. It has excellent insulation properties, will not support combustion, and never needs painting.

Find out how this light, inexpensive, long-wearing pipe can make your operations more efficient. Fill in and mail the coupon on the right. *B.F.Goodrich Industrial Products Company, Marietta, Ohio.*

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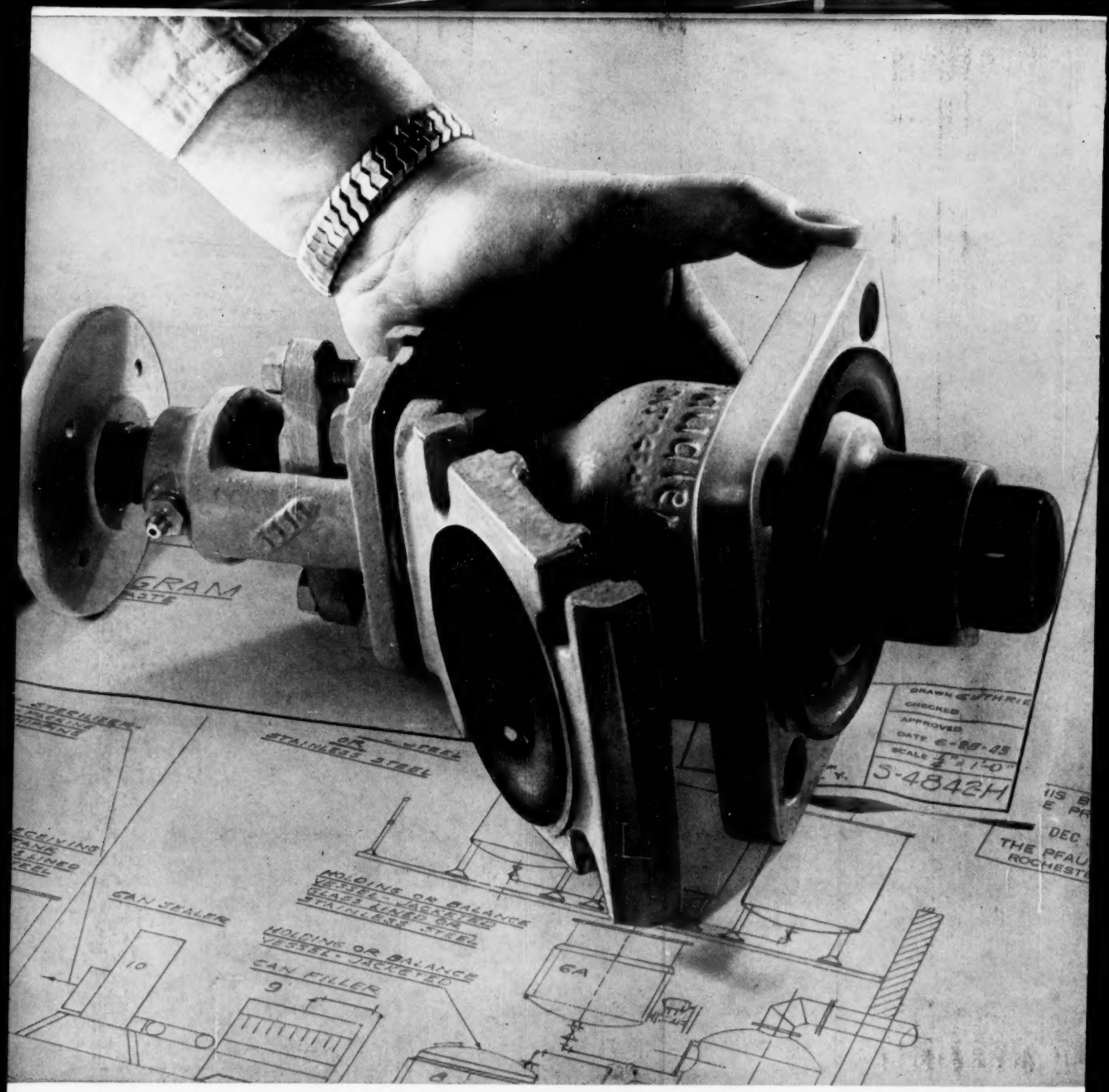

No cracking, no crackling in new all-glassed valve

By taking out all the porcelain in this bottom outlet flush valve, we eliminated a major cause of valve failure.

We made head and stem a one-piece, uncemented unit. Then we glassed it all over.

No cracking. The seat of the new valve is made from rigidized Teflon-glass fiber. Its bevel mates perfectly with that of the glassed spherical head. Since Teflon has "give," you can set the valve firmly without cracking the head covering.

No crackling. Rubbing the glass head against the Teflon-glass fiber seat can never develop static electricity.

We need hardly mention the positive and leakproof sealing you get with the ball-joint design. And it's probably just as self-evident that the rounded glassed head prevents product build-up around the valve during processing.

So all we have left to tell is that the new valve costs no more than a conventional stainless steel valve. It's interchangeable with almost any valve you might now be using. It comes in six sizes ranging from 1½ by 1 to 8 x 6.

O.E.M. discounts are available.

Anything more you might want to know is covered in our Data Sheet 42. Write Dept. CEB-48 for a copy.

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